Department of Economics

Essays on the Cost of Debt Capital for Private Firms

Patricio Valenzuela

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

Florence, May 2012

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Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

CONTENTS

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

ABSTRACT

Since corporate investment is a key driver for economic growth, it is very important to find out what are the drivers of the cost of financing for private firms. In particular, this thesis studies the determinants of spreads of bonds issued by advanced and emerging market borrowers and the determinants of foreign-currency corporate credit ratings.

Chapter 1 demonstrates that the impact of debt market illiquidity on corporate bond spreads is exacerbated with a higher proportion of short-term debt. This effect is present in both investment-grade and speculative-grade bonds and is smaller in banks as they may have the support of a lender of last resort during periods of market illiquidity. The paper's major finding is consistent with the predictions of structural credit risk models that argue that a higher proportion of short-term debt increases the firm's exposure to debt market illiquidity through a 'rollover risk' channel.

Although credit rating agencies have gradually moved away from a policy of never rating a corporation above the sovereign (the 'sovereign ceiling'), it appears that sovereign credit ratings remain a significant determinant of corporate credit ratings. Chapter 2 examines this link using credit rating data for advanced and emerging economies over the period of 1995 to 2009. The results are consistent with a sovereign ceiling 'lite' policy or ceiling that is not an absolute constraint, but a limitation that tends to decrease corporate ratings when these ratings are above the sovereign rating.

Finally, chapter 3 investigates the impact of capital account restrictions on spreads of corporate bonds issued in international markets by developed and emerging market borrowers. The main finding is that capital account restrictions on inflows significantly increase corporate bond spreads. A second main finding is that capital account restrictions on inflows matter a great deal more during times of financial distress.

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Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
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CHAPTER 1

ROLLOVER RISK AND CORPORATE BOND SPREADS

The financial crisis of 2007 to 2009 hit international debt markets hard and produced a significant widening of corporate bond spreads. According to the literature on the determinants of corporate bond spreads, the main factors that may have affected these spreads during the crisis are default and liquidity risks. However, the financial crisis has also highlighted the importance of rollover risk as a significant additional factor for consideration in the pricing of corporate bonds. Although there is a rich body of literature examining the influence of default risk and market illiquidity on corporate bond spreads (e.g., Merton (1974), Collin-Dufresne et al. (2001), Campbell and Taksler (2003), Chen, Lesmond and Wei (2007), Covitz and Downing (2007), Bao, Pan, and Wang (2010)), research on the role of rollover risk in corporate debt markets is still in its infancy.

During episodes of market illiquidity, rollover risk appears to be particularly relevant. Firms with high levels of short-term debt to total debt and without access to new capital at a reasonable cost may incur substantial rollover losses that increase their probabilities of default. Figure 1 shows that the impact of the financial crisis of 2007 to 2009 was particularly strong for bonds issued by banks and financial corporations and bonds with lower credit ratings. A potential reason for the divergence of corporate bond spreads across sectors is the previously mentioned rollover risk, as banks and financial corporations are more prone to rollover losses given their high levels of short-term debt relative to their total debt.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
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[Insert Figure 1 about here.]

Using a new data set on corporate bonds placed on international markets for the period January 2004 to June 2009, this paper shows that the impact of debt market illiquidity on corporate bond spreads is exacerbated in firms with higher levels of short-term debt over total debt. This result is significant, even after controlling for all known determinants of corporate bond spreads and the potential heterogeneous effects of debt market illiquidity (e.g., flight-to-quality and too-big-to-fail) and is robust to alternative measures of debt market illiquidity, to including bond- and time-fixed effects and to potential endogeneity bias.[1] In addition, the main finding in this paper is consistent with the predictions of first-passage structural credit risk models, such as the one introduced by He and Xiong (2012), in which the impact of debt market illiquidity affects corporate bond spreads through a 'rollover risk' channel.

Rollover risk is priced in both investment-grade and speculative-grade bonds, but its impact on spreads is higher for speculative corporate bonds. For investment-grade bonds, during the episode of high debt market illiquidity at the end of 2008, rollover risk predicts a difference of approximately 85 basis points between the spread of bonds issued by firms with short-term debt to total debt ratios at the 75th and 25th percentiles. For speculative-grade bonds, this magnitude is approximately 230 basis points. During the same episode of market illiquidity, the average spreads of investment-grade

[1] According to Gopalan, Song and Yerramilli (2010), firms that have a higher proportion of short-term debt over total debt tend to be less risky and less likely to experience deteriorations in their credit quality. Therefore, estimations that do not correct for the endogeneity of rollover may potentially underestimate the true impact of rollover on the deterioration in credit quality.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

and speculative-grade corporate bonds were approximately 475 basis points and 1,290 basis points, respectively. Therefore, the magnitudes associated with rollover risk during periods of market illiquidity are economically significant. The results also indicate that banks are more resilient to the marginal effect of debt market illiquidity through a rollover risk channel, which is consistent with the possibility that banks may have the support of a lender of last resort during episodes of market illiquidity.

In view of the financial crisis of 2007 to 2009, firms' maturity debt structures have been viewed as an important component of corporate bond spreads. Golapan, Song and Yerramilli (2010) show that long-term bonds issued by firms with a higher proportion of debt maturing within the year trade at higher spreads and are more likely to experience multi-notch rating downgrades. Hu (2010) demonstrates that firms with a proportion of expiring long-term debt higher than 0.2 experienced higher spreads during the second half of 2008. Although the results presented in these studies are consistent with the argument that a higher proportion of short-term debt exposes firms to rollover risk, our understanding of the channels through which rollover risk affects corporate bond spreads remains limited.

This paper contributes to the literature on the determinants of corporate bond spreads in several ways. First, it contributes to the empirical literature by exploring an important channel through which debt market illiquidity affects corporate bond spreads, i.e., the rollover risk channel. The paper's major finding suggests that firms with a higher proportion of short-term debt are more vulnerable to debt market illiquidity. Ignoring this heterogeneity when considering the impact of debt market illiquidity on corporate bond spreads and adhering to standard models on the pricing of

DOI: 10.2870/41878

corporate bonds may be undesirable in times of market illiquidity, as this approach may bias the results. Second, in contrast to the commonly held position, the results in this paper empirically demonstrate that liquidity and default risks are not independent determinants of corporate bond spreads. In fact, the results of this study suggest an interaction between liquidity and default premiums whereby the debt market illiquidity increases the firm's probability of default through rollover risk. Finally, by showing that banks are less affected by the marginal effect of debt market illiquidity through a rollover risk channel, this paper contributes to the current debate regarding the regulation of banks and financial corporations.

The remainder of the paper is organized as follows. Section I briefly presents the theoretical framework that supports the empirical tests conducted in this paper. Section II describes the characteristics of the data and sample. Section III presents the empirical results. Section IV addresses potential endogeneity. Section V concludes the paper.

I. The Theoretical Framework

This section presents a theoretical discussion of the rollover risk channel through which debt market illiquidity influences corporate bond spreads. First-passage structural credit risk models frame the most important issues.

Extending Leland and Toft's structural credit risk model (1996), which considers illiquid bond markets and firms that finance their capital with equity, short-term and long-term debt, He and Xiong (2012) show that market illiquidity increases corporate bond spreads and argue that this effect is exacerbated in firms with higher levels of short-term debt in relation to total debt. Under the

DOI: 10.2870/41878

assumption of a stationary debt structure, implying that when a bond matures, firms replace it by issuing a new, identical bond, the impact of rollover risk on corporate bond spreads is demonstrated by the following mechanism: A negative shock in market liquidity increases the liquidity premium, driving the prices of firms' newly issued bonds down. If the market value of the newly issued bonds drops below its principal value, firms incur rollover losses. These losses are higher in firms with higher short-term debt to total debt ratios, as short-term debt is rolled over at a higher frequency. Rollover losses reduce the firm's equity value at a higher endogenous default boundary, thus increasing the probabilities of default and, in turn, increasing corporate bond spreads. In the model presented by He and Xiong (2012), default occurs endogenously when the assets drop to a low boundary at which the equity value becomes zero.

Therefore, structural credit risk models generate predictions of the impact of market illiquidity on corporate bond spreads through a rollover risk channel.

II. Sample Characteristics and Data Description

Using Bloomberg Professional, I constructed a new data set of investment-grade and speculative-grade corporate bonds placed in international markets by developed and emerging market borrowers. The period under study is from January 2004 to June 2009. The data set consists of month-end data and considers all fixed-rate bonds that are denominated in U.S. dollars and available to Bloomberg in June 2009, with the exception of bonds issued by firms located in the U.S.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

or England.[2] The rationale behind excluding the economies in which the crisis incubated is to reduce potential endogeneity problems in the causal impact of debt market illiquidity on corporate bond spreads. Despite these exclusions, as I show here, the behavior of my spread data mimics the behavior of spread indexes widely used by investors quite well and represents nearly the entire universe of corporate bonds denominated in U.S. dollars. The data set contains bonds issued by publicly traded firms in the financial and nonfinancial sectors. The distribution of issuers by sector in the final sample is as follows: industrial (53.9%), banking (17.1%), financial (9.0%), utility (8.6%), telephone (7.8%), oil and gas (2.4%), and transportation (1.2%).

It is important to emphasize that international corporate bonds denominated in U.S. dollars are an important segment of bond markets. Using data from 1991 to 2005, Gozzi et al. (2010) show that 35% of the capital raised through debt issues was raised in international markets. Moreover, international debt issues tend to be denominated in foreign currencies (Hausmann, and Panizza (2010); Gozzi et al. (2012)). As reported by the Bank of International Settlements (BIS), by June 2009, approximately 65% of the outstanding international debt of emerging market borrowers was denominated in U.S. dollars.

To reduce potential coding errors, I clean the data in four ways. First, I eliminate the top and bottom 0.5% of the spreads from my analysis. Second, I exclude all observations in which any of the accounting variables exceeds the sample mean by more than five standard deviations. Third, I do not consider bonds issued in countries in which the total number of observations was lower than

[2] The countries included in the final sample are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Panama, Peru, Philippines, Singapore, South Korea, Spain, Sweden, Switzerland, and Thailand.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

30.[3] Fourth, I restrict the sample to bonds issued by firms with an S&P credit rating between AAA and B-. After the cleaning of the data, the final sample, including all the control variables, contains 21,375 bond-month observations, of which 16,691 correspond to investment-grade bonds and 4,684 correspond to speculative-grade bonds.

A. Corporate Bond Spreads

The dependent variable is the corporate *option-adjusted spread* (OAS) from Bloomberg. In short, it represents the spread over an issuer's spot rate curve (i.e., the theoretical yield on a zero-coupon U.S. Treasury security). It is derived by positing a distribution of millions of interest rate paths (using a one-factor, arbitrage-free binomial tree of normally distributed short rates) consistent with the current 'riskless' Treasury term structure. The bond's call schedule is then examined, and the interest rate paths are used to discount the cash flows from the corporate bonds necessary to arrive at their present values, while the cash flows depend on the level of interest rates.[4] The present values are averaged to obtain an expected value, which can be viewed as the theoretical price of the bond. The OAS is the constant spread over the underlying Treasury term structure across each path that makes the theoretical value of the bond equal to the market price of the bond.

Fabozzi (2006) emphasized that when the OAS is measured over a U.S. Treasury security, as in this case, the OAS captures the credit spread, a liquidity premium, and any richness or cheapness of the bond after adjusting for the effects of any embedded options. The use of the OAS in this study

[3] The bonds eliminated in this cleaning of the data correspond to bonds issued in the Bahamas, China, and Hong Kong.
[4] For instance, the probability of the occurrence of a cash flow prior to the call period is 100%, but the probability of the occurrence of a cash flow occurring after the call period begins depends on the possible paths of interest rates up to the time of the cash flow.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

is crucial, given that in general, corporate bonds contain embedded options, causing 57% of the bonds in my sample to contain contingent cash flows due to call or put features. Note that the OAS methodology does not affect my results, as they are robust to splitting my sample between bonds without embedded options (in which the option value is zero) and bonds with embedded options.[5]

To explore whether my OAS data suffer from any selection bias, it is interesting to compare it with the OAS indexes widely used by investors. In Figure 2, I plot the average OASs from my data beside the OAS indexes reported by Bank of America (BofA) Merrill Lynch. I plot each series for each credit rating category with their respective correlations. It is noteworthy that while there are some discrepancies between the two series, the indexes constructed from my data set adequately mimic the behavior of the BofA Merrill Lynch OAS indexes and, therefore, the universe of bonds given a set of characteristics such as credit rating, currency, amount issued, and time to maturity.[6] For all the reported credit rating categories, the levels in both indexes are similar and their correlations are close to one, suggesting that my spread data are quite representative of the universe of corporate bonds denominated in U.S. dollars and that the results presented here are unlikely to be driven by sample selection bias.

[Insert Figure 2 about here.]

[5] Other studies using OASs are, for example, Becchetti et al. (2010), Cavallo and Valenzuela (2010), Huang and Kong (2003), and Pedrosa and Roll (1998).

[6] The BofA Merrill Lynch OAS indexes correspond to weighted averages based on the outstanding amount of each bond. According to the data restrictions, the OAS weighted averages from my data are based on the issued amount. In addition, given that the U.S. Corporate BofA Merrill Lynch indexes by credit rating are only available for bonds issued in investment-grade countries of risk, in the construction of my indexes, I do not consider bonds issued in countries granted a lower than investment-grade credit rating. The index criteria used by BofA Merrill Lynch are available at http://www.mlindex.ml.com.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table I summarizes the mean spread before and after the Lehman Brothers bankruptcy using the S&P credit rating and the number of years to maturity. For the two period samples and for the different years-to-maturity categories, the table shows that OASs increase as the quality of the credit rating decreases. The table also indicates that OASs are considerably higher in the period of financial distress following the Lehman Brothers bankruptcy.

[Insert Table I about here.]

B. Debt Market Illiquidity

In view of the financial crisis of 2007 to 2009 and its effects, this paper focuses on the systematic implications of debt market illiquidity and utilizes debt market illiquidity measures rather than bond-specific measures. Furthermore, it is generally known that there is a significant level of commonality in measures of bond illiquidity, indicating a significant systemic illiquidity component (Bao, Pan, and Wang (2010), Chordia, Sarkar, and Subrahmanyam (2005)).

The five measures of debt market illiquidity used in this paper are the Gamma measure, the Noise measure, the On/off-the-run U.S. Treasury spread, the Supranational AAA spread, and the KfW spread. Due to space considerations, I present all my results using the Gamma measure, which is constructed using corporate bond prices, and only use the other measures for the purpose of robustness in my baseline estimations. The results in this paper are qualitatively similar regardless of

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

the measure used. Appendix A shows the correlation matrix among the five measures of debt market illiquidity.[7]

The Gamma measure

The Gamma measure is the negative of the autocovariance of price changes. The construction of this measure is based on the fact that illiquidity arises from market frictions and that its impact on the markets is transitory. Given that transitory price movements produce negative serially correlated price changes, the Gamma measure creates a meaningful measure of debt market illiquidity that captures the impact of illiquidity on prices. This paper uses the aggregated Gamma measure that is obtained by aggregating the Gamma measure across individual bonds. This measure is adopted from Bao, Pan and Wang (2011), who construct it using information regarding the U.S. secondary corporate bond markets from the TRACE dataset.

The Noise measure

The Noise measure is the aggregation of the price deviations across all bonds. These deviations are constructed by calculating the root mean squared distance between the market yields and the yields from a smooth zero-coupon yield curve. The main concept behind this measure is that the lack of arbitrage capital reduces the power of arbitrage, and assets can be traded at prices deviating from their fundamental values. Therefore, this 'noise' in prices contains important information

[7] Although these measures are constructed using data from different debt markets and denominated in different currencies (e.g., the KfW spread is denominated in euros), based on the commonality of liquidity across markets, these measures are useful to test whether they can be used comprehensively as measures of market illiquidity in bond markets.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

about the amount of liquidity in the aggregate market. This measure is adopted from Hu, Pan and Wang (2011), who analyze 'noise' in the prices of U.S. Treasury bonds.

The On/off-the-run U.S. Treasury spread

The On/off-the-run U.S. Treasury spread is the spread between the yield of on-the-run and off-the-run U.S. Treasury bonds. Although the issuer of both types of bonds is the same, in general, on-the-run bonds trade at a higher price than similar off-the-run bonds due to the greater liquidity and specialness of the on-the-run bonds in the repo markets. This specialness refers to the fact that holders of on-the-run Treasury bonds are frequently able to pledge them as collateral and borrow in the repo market at considerably lower interest rates than those of similar loans collateralized by off-the-run Treasury bonds (Sundaresan and Wang (2009)). I compute the On/off-the-run U.S. Treasury spread using 10-year bonds, given that the spread tends to be very small and noisy at smaller maturities. The data sources used in the construction of this spread are Gürkaynak et al. (2007) and the Board of Governors of the Federal Reserve System.

The Supranational AAA spread

The Supranational AAA spread is the yield spread between supranational AAA bonds and U.S. Treasury bonds. Because U.S. Treasury and supranational bonds are traditionally considered 'safe havens' due to their negligible default risks and U.S. Treasury bonds are, in general, the most liquid bonds, any difference between supranational AAA bonds and U.S. Treasury bonds should be driven mainly by the liquidity premium. I compute the Supranational AAA spread using bond yield indexes

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

from BofA Merrill Lynch. The yield indexes considered include U.S. dollar denominated bonds with a time to maturity of between 1 and 3 years.

The KfW spread

The KfW spread is the spread between KfW bonds and German governmental bonds. As KfW bonds are bonds supported by the *explicit* guarantee of the German federal government, the KfW spread represents the liquidity premium that investors are willing to pay for the greater liquidity of the federal government bonds in comparison to KfW bonds. The KfW spread is denominated in euros and is computed using two-year bonds. This spread is adopted from Schwarz (2010).

C. Short-term Debt

According to the theoretical framework introduced by He and Xiong (2012), rollover losses increase with debt market illiquidity, and this effect is stronger for firms with higher short-term debt to total debt ratios. Therefore, in the empirical model presented in the next section, I consider debt market illiquidity and its interaction with the short-term debt to total debt ratio as determinants of corporate bond spreads. The short-term debt to total debt ratio is constructed using accounting data from Bloomberg and is calculated as the ratio of short-term borrowings over total borrowings.

D. Other Corporate Bond Spread Determinants

To control for all variables that could directly affect corporate bond spreads, in all specifications, I consider a powerful set of variables. The choice of the control variables is based primarily on

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

structural credit risk models and the empirical literature on the determinants of corporate bond spreads (see, e.g., Collin-Dufresne et al. (2001) and Campbell and Taksler (2003)). The descriptions, units, frequency and sources of the variables are presented in Appendix B.

At the bond level, all the regressions include bond-fixed effects, and I control for the time to maturity. Bond-fixed effects control for the endogeneity arising from time-invariant bond/firm heterogeneity. At the firm level, I control for Standard and Poor's (S&P) corporate credit rating in all specifications.[8] Because credit ratings mainly consider the long-term and structural components of default risk (Löffler (2004), Standard and Poor's (2001)), I also consider the issuer's equity volatility and a standard set of accounting variables, as in Campbell and Taskler (2003). The accounting variables considered are the ratio operating income to sales, the ratio of short-term debt to total debt, the ratio of total debt to assets, and firm size.[9] As balance sheet variables are reported quarterly, following Collin-Dufresne et al. (2001), I estimate monthly observations using linear interpolation.[10]

At the country level, I also include the S&P sovereign credit rating to control for a broad range of country time-risk factors correlated with sovereign risks, which may affect the credit risk of private firms. Finally, I consider the interaction between corporate credit rating and debt market liquidity to control for a potential 'flight-to-quality' effect, in which investors abandon risky bonds in

[8] Although there is a well-known nonlinear relationship between credit ratings and spreads, the results are nearly identical when controlling for credit ratings or credit-rating dummies. There are two reasons for this. First, I split the sample between investment-grade and speculative-grade bonds, which captures some of this nonlinear relationship. Second, in all regressions, I control for the known determinants of credit risk and, thus, of credit ratings. For the purpose of parsimony, I report the results using the credit-rating variable rather than credit-rating dummies.
[9] Although my main results are robust to the inclusion of the pretax interest coverage, I exclude this variable in my baseline regression, as my sample size drops considerably when it is added.
[10] The main results in this paper are, for the most part, identical when using quarterly or monthly data.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

favor of safer bonds during periods of market illiquidity. Table II characterizes the variables considered in my final sample of bonds for each year.

[Insert Table II about here.]

III. Regression Analysis

A. Corporate Bond Spreads and Rollover Risk

The central question of this study is to explore whether debt market illiquidity affects corporate bond spreads through a rollover risk channel. Thus, my baseline specification is as follows:

$$\begin{aligned}\text{Bond Spread}_{bfct} = {} & \eta_0 + \eta_1 \text{Maturity}_{bfct} + \eta_2 \text{Equity Volatility}_{fct} + \eta_3 \text{Credit Rating}_{fct} \\ & + \eta_4 \text{Operating Income/Sales}_{fct} + \eta_5 \text{ST Debt/Debt}_{fct} + \eta_6 \text{Debt/Assets}_{fct} \\ & + \eta_7 \text{Size}_{ct} + \eta_8 \text{Sovereign Rating}_{ct} + \eta_9 \text{Rating}_{jct} \text{ x Debt Market Illiquidity}_t \\ & + \eta_{10} \text{ST Debt/Total Debt}_{fct} \text{ x Debt Market Illiquidity}_t + \mathbf{A}_b + \mathbf{B}_t + \varepsilon_{bfct},\end{aligned}$$

where the subscript *'bfct'* refers to bond *b*, firm *f*, country *c,* and time *t*. $\mathbf{A}_b$ and $\mathbf{B}_t$ are vectors of bond and time dummy variables that account for bond- and time-fixed effects, and ε_{bfc} is the error term. The main parameter of interest is η_{10}.

Table III presents the main results of my estimation of the baseline regression by ordinary least squares with the errors clustered by bond. The table presents the results for five alternative measures of debt market illiquidity: the Gamma measure, the Noise measure, the On-/off-the-run Treasury

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

spread, the Supranational AAA spread, and the KfW spread. Columns 1 to 5 report the results for the investment-grade sample. Columns 6 to 10 report the results for the speculative-grade sample.

[Insert Table III about here.]

The results are consistent with the theoretical framework introduced by He and Xiong (2012), suggesting that a higher proportion of short-term debt increases the firm's exposure to debt market illiquidity through a rollover risk channel, which increases the firm's bond spreads. All the coefficients of the interaction term between the proportion of short-term debt and debt market illiquidity are positive and highly statistically significant. Thus, this paper's major finding is robust to the five measures of debt market illiquidity in both the investment-grade and speculative-grade samples.

The results also suggest the presence of a 'flight to quality' effect, whereby bonds that are less risky in terms of their credit rating quality are relatively less affected by episodes of market illiquidity, as investors may 'fly' from risky bonds to safer bonds. Models 1 to 10 show that the coefficients associated with the interaction between corporate credit rating and debt market illiquidity are negative and highly statistically significant. Additionally, the results show that the spread of investment bonds is less sensitive to market illiquidity than the spread of speculative grade bonds.

In times of market illiquidity, the proportion of the spreads explained by debt market illiquidity through a rollover risk channel is economically important. One way to evaluate the magnitude of the rollover risk's effect on corporate bond spreads is to consider the following. Given a Gamma

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

measure of 330, as was the case at the end of 2008, the coefficients estimated in model 1 in Table III predict that the spreads of investment grade bonds issued by firms with short-term to total debt ratios in the 75th percentile are approximately 85 basis points higher than the spreads of speculative bonds issued by firms with short-term to total debt ratios in the 25th percentile. Additionally, the coefficients estimated from model 6 in Table III predict that this magnitude is approximately 230 basis points in the speculative-grade bond sample. For the same period of market illiquidity, the spread of investment-grade and speculative-grade corporate bonds were, on average, approximately 475 basis points and 1,290 basis points, respectively. These magnitudes suggest that a firm's maturity debt structure can explain an important proportion of the divergence of corporate bond spreads during episodes of debt market illiquidity.

Most of the coefficients associated with the control variables have the expected sign, although many of them are not statistically significant. However, it is noteworthy that in unreported regressions, including industry- and country-fixed effects rather than bond-fixed effects, nearly all the coefficients are highly significant in the expected directions, and their magnitudes are consistent with those reported in previous studies (see, e.g., Campbell and Taksler (2003)). This suggests that it is primarily the variation across bonds/firms that provide the explanatory power of those control variables that are not significant in the specification using bond-fixed effects.

B. Banks versus Non-Banks

In times of market illiquidity, bonds issued by banks exhibit higher spreads than bonds issued by nonbanks, as banks are more exposed to rollover losses as a result of their higher levels of short-term debt over total debt. However, because banks often have a lender of last resort that may

alleviate the cost of rolling over their maturing debt in periods of market illiquidity, I would expect bonds issued by banks to be more resilient to the influence of debt market illiquidity through a rollover risk channel.

To explore whether the impact of debt market illiquidity on corporate bond spreads through a rollover risk channel differs across sectors, Columns 1 and 2 of Table IV divide my sample between banks and nonbanks, respectively. As expected, the results indicate that banks are less affected than nonbanks by the marginal effect of debt market illiquidity through a rollover risk channel. In fact, the coefficient of the interaction term in the bank sample is approximately half that of the nonbank sample. This result is consistent with the assumption that banks have a lender of last resort in periods of market illiquidity.[11]

[Insert Table IV about here.]

C. Subsamples

Table IV also explores other subsamples. Although the OAS is a standard methodology in financial markets for computing the embedded value of the eventual embedded option of the bond (e.g., a call option), this methodology may introduce some errors to the measurement of my dependent variable. To explore whether the OAS methodology is driving the results, columns 3 and

[11] I also explore this issue in unreported regressions, augmenting my baseline regressions with three interaction terms: the interaction between a bank dummy variable and debt market illiquidity; the interaction between a bank dummy variable and the proportion of short-term debt; and the interaction between a bank dummy variable, the proportion of short-term debt, and debt market illiquidity. The results of these regressions are consistent with those reported in columns 1 and 2 of Table 4. I prefer to report my results using different samples, as this approach provides a more general estimation and allows for different coefficients for the control variables.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

4 divide my sample between bonds without embedded options (in which the option value is zero) and with embedded options, respectively. The results suggest that the OAS methodology does not drive my main results, as the coefficients of the interaction term between debt market illiquidity and the proportion of short-term debt remain positive and highly significant in both samples.

Finally, Table IV investigates whether the interpolation of my quarterly firm-level variables into monthly frequency affects the results. To rule this possibility out, column 5 re-estimates my baseline regression using quarterly data. Once again, the results remain qualitatively unchanged.

IV. Endogeneity

Although bond-fixed effects may reduce some endogeneity concerns, they do not address the endogeneity associated with time-varying bond/firm characteristics. Therefore, this section explores whether the results are robust to controlling for endogeneity more exhaustively. There are three good reasons to believe that endogeneity may be driving the results. First, the level of short-term debt to total debt may shift simultaneously with other bond- and firm-level characteristics, and it may be these additional variables that drive the results. For instance, a reduction in the firm's share of short-term debt may be part of a firm strategy that also includes a leverage reduction. Therefore, the short-term to total debt ratio may take on a leverage effect rather than a rollover risk effect. Second, debt market illiquidity is likely to occur simultaneously with credit market deterioration. Thus, systemic default risk may be driving the debt market illiquidity effect. Third, because the maturity debt structure of a firm is a managerial decision, the short-term debt to total debt ratio may

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

depend on the firm's credit risk level, as reflected in its spreads. The analysis developed here presents additional evidence suggesting that it is unlikely that endogeneity is driving the main results.

A. Is the Short-term Debt to Total Debt Ratio a Proxy for other Firm or Bond Characteristics?

Given that my measure of rollover risk is constructed as the interaction between the short-term to total debt ratio and debt market illiquidity, it is possible that these variables are proxies for something else. The first possibility is that the short-term debt to total debt ratio may take on other contemporaneous variables. Table V presents the results of more explicit testing for this possibility by including a number of additional interaction terms. The four added terms correspond to the interaction of equity volatility, total debt to total assets, size of the firm, and years to maturity with debt market illiquidity. On the one hand, I expect bonds issued by firms with greater equity volatility and leverage to be more vulnerable to episodes of market illiquidity. On the other hand, I expect bonds issued by larger firms and with a longer time to maturity to be more resilient to episodes of market illiquidity.

Table V shows that all my previous results remain relatively unchanged, while all the coefficients associated with the new interaction terms (with the exception of the interaction between size and debt market illiquidity in the speculative-grade sample) have the expected sign, although most of them are not statistically significant at the standard levels of confidence. These results (i.e., that only credit ratings and the proportion of short-term debt exacerbate the impact of debt market illiquidity) suggest that in times of market illiquidity, credit ratings adequately account for a powerful set of

bond/firm characteristics but do not account for the firm's maturity structure, a conclusion that is consistent with Golapan, Song and Yerramillin (2010)'s major finding.

[Insert Table V about here.]

B. Is Debt Market Illiquidity a Proxy for Credit Deterioration?

Another possibility is that my debt market illiquidity variable may pick up other contemporaneous variables (e.g., systemic credit risk deterioration). To rule this possibility out, I augment my baseline regression with the interaction of the short-term debt to total debt ratio with two variables. The first variable is the three-month Libor-OIS spread, which is the difference between the London inter-bank offer rate and the overnight index swap rate. The second variable is the three-month TED spread, which is the difference between the interest rate on inter-bank loans and the 'T-bills' rate. It is generally understood that these spreads contain both liquidity and default premiums. For example, Schwarz (2009) decomposes the Libor-OIS spread on market illiquidity and credit risk, finding that market illiquidity explains more than two-thirds of the widening of the euro Libor-OIS spread.

To account for the close relationship between these two spreads and market illiquidity, I include only the part of these measures that is unrelated to the liquidity premium. To this end, I first regress each measure of my debt market illiquidity variable and then use the residual from that equation in my baseline regression. The resulting residual retains all the financial information except market illiquidity.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table VI presents the results of my augmented regressions. Once again, my main results remain qualitatively unchanged, and my coefficient of interest remains highly significant. In addition, the positive coefficients on *'ST Debt/Debt x Libor-OIS spread residual'* and *'ST Debt/Debt x TED spread residual'* suggest that the systematic credit risk's impact on spreads is also exacerbated by the short-term debt to total debt ratio.

[Insert Table VI about here.]

C. Instrumental Variables Generalized Method of Moments (IV-GMM) Estimation

As firms may choose their maturity debt structure to balance the smaller borrowing costs and rollover losses usually associated with short-term borrowing and according to their credit risk profiles and other firm characteristics (Diamond (1991), Barclay and Smith (1995)), the choice of the firm's debt structure is an endogenous decision. To control for potential reverse causality, I replicate my baseline specifications using a two-step efficient IV-GMM estimator.[12]

The instrumental variables approach implemented in this paper is based on two observations. First, leverage ratios and maturity debt structures appear to be stationary. Several empirical studies support the existence of a pre-established target in leverage and short-term debt to total debt ratios (Antoniou et. al (2006), Jalilvand and Harris (1984), Opler and Titman (1997), Deesomsak et. al (2009)). In addition, Barclay and Smith (1995) show that it is the variation between firms that provides explanatory power in regressions on the determinants of the firm's debt maturity structure:

[12] The efficiency gains of this estimator relative to the traditional IV/2SLS estimator is derived from the use of the optimal weighting matrix, the over-identification restrictions of the model, and the relaxation of the identical and independently distributed assumptions.

they obtain adjusted R^2s of 0.16 and 0.26 in pooled and cross-sectional regressions with a much smaller R^2 of 0.02 in fixed-effects regressions when the explanatory power of the fixed effects is excluded. [13] Second, the recent financial crisis was largely unexpected. Therefore, it is unlikely that the short-term debt to total debt ratios before the crisis reflected risks associated with the financial crisis. This should be particularly true in the sample of countries covered in this study, which excludes the U.S. and England.

In light of these observations, I estimate my baseline specifications using a two-step efficient IV-GMM estimator for the period from January 2007 to June 2009. I instrument short-term debt to total debt and its interaction with debt market illiquidity with the firm-fixed effects from a regression of short-term debt to total debt on firm dummies and with the three- and six-month lags of the interaction between debt market illiquidity and the same firm-fixed effects. The firm-fixed effects are estimated using the period prior to January 2007. Therefore, their values should reflect the pre-established target in the short-term debt to total debt ratios that is unrelated to the risks associated with the period from January 2007 to June 2009. Additionally, to reduce the potential endogeneity of my control variables, I use three-month lags for all the independent variables.

Table VII reports the results for the second-stage of the two-step efficient IV-GMM estimator for the regressions reported in columns 1 and 6 in Table III. The results remain largely unchanged from my previous results. The table also presents the F-test and R-squared of the excluded instruments and the p-values for the Hansen's J test of over-identifying restrictions (Baum, Schaffer, and Stillman (2003)). The F-test and R-squared of the excluded instruments indicates that the

[13] The sample used in this study appears to be consistent with this observation. In fact, firm-fixed effects can explain most of the variance of the short-term debt to total debt ratios. Moreover, the statistics reported in Table II show that short-term to total debt ratios have been relatively stable during the entire study period.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

instruments and endogenous variables are correlated, even after netting out the effects of all other exogenous variables. Furthermore, the J test cannot reject the null hypothesis that all the instruments are valid. Overall, the entire set of robustness checks presented in this paper suggests that it is unlikely that my main results are be driven by endogeneity bias.

[Insert Table VII about here.]

V. Conclusions

This paper demonstrates that the impact of debt market illiquidity on corporate bond spreads is exacerbated with a higher proportion of short-term debt through a rollover risk channel. This effect is present in both investment-grade and speculative-grade bonds, is stronger in speculative-grade bonds and is smaller in the banking sector. In addition, the rollover risk channel is able to explain an important proportion of the divergence of corporate bonds across firms and sectors during the financial crisis of 2007 to 2009. The paper's major findings are consistent with the predictions of recent structural credit risk models and contribute to the empirical literature on the modeling of corporate bond spreads around periods of market illiquidity. Although the impact of debt market illiquidity on corporate bonds spreads through rollover risk appears important, this channel has been ignored in prior empirical studies.

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Appendix A
Correlation between Alternative Debt Market Illiquidity Measures

This table presents the correlation matrix of five debt market illiquidity measures: the Gamma measure, the Noise measure, the On-/off-the-run Treasury spread, the Supranational AAA spread, and the KfW spread.

	Gamma measure	Noise measure	On/off-the-run Treasury spread	Supranational AAA spread	KfW spread
Gamma measure	1.00				
Noise measure	0.95	1.00			
On/off-the-run Treasury spread	0.95	0.94	1.00		
Suprabational AAA spread	0.90	0.92	0.92	1.00	
KfW spread	0.94	0.94	0.94	0.97	1.00

Appendix B
Description of Variables

This table describes the variables used in the empirical model, presenting the variables' names, descriptions, units, and sources.

Name	Description	Unit	Source
Bond spread	Option-adjusted spread	Basis points	Bloomberg
Years to maturity	Years to maturity	Years	Bloomberg
Issue size	Amount issued	US$ (in *log*)	Bloomberg
Coupon rate	Coupon bond	Basis points	Bloomberg
Equity volatility	Volatility is the standard deviation of the day-to-day logarithmic price changes. A previous day's 180-day price volatility equals the annualized standard deviation of the relative price change of the most recent trading day's closing price, expressed in a percentage for the day prior to the current.	Percent	Bloomberg
Credit rating	Standard and Poor's firm rating, long-term debt, foreign currency	(1=D, …, 21=AAA)	S&P
Operating income to sales	Operating income divided by net sales	Ratio	Bloomberg
ST debt to total debt	Short-term debt divided by total debt	Ratio	Bloomberg
Total debt to assets	Total debt divided by total assets	Ratio	Bloomberg
Size	Total assets	Millions of US$ (in *log*)	Bloomberg
Sovereign credit rating	Standard and Poor's sovereign rating, long-term debt, foreign currency	(1=D, …, 21=AAA)	S&P
Gamma measure	Negative of the autocovariance of price changes	Basis points	Bao, Pan and Wang (2010)
Noise measure	Root mean squared distance between the market yields and the yields from a smooth zero-coupon yield curve	Basis points	Hu, Pan and Wang (2011)
On/Off-the-run treasury spread	Difference between the yield to maturity of 10 years of off-the-run and on-the-run treasury bonds	Basis points	Board of Governors of the Federal Reserve System
Supranational AAA spread	Difference between the supranational AAA 1-3-year yield index and the treasury 1-3-year yield index	Basis points	DataStream
KfW spread	Difference between 2-year KfW bonds and German federal government bonds	Basis points	Schwarz (2010)
Libor-OIS spread	Spread between the three-month OIS rates and LIBOR rates	Basis points	Bloomberg
Ted spread	Difference between the three-month U.S. treasury bill rate and the three-month London Interbank Borrowing Rate (LIBOR)	Basis points	Bloomberg

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

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Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

Table I
Average Corporate Option-Adjusted Spreads

Using panel data between January 2004 and June 2009, this table reports corporate option-adjusted spreads in basis points by credit rating and years to maturity. All the bonds are denominated in U.S. dollars. The table reports option-adjusted spreads for the periods before and after the Lehman Brothers bankruptcy.

	S&P Credit Rating						
Corporate bond spreads (bps)	AAA	AA	A	BBB	BB	B	All ratings
			January 2004 to August 2009				
Short maturity (0-3 years)	83	108	151	226	438	694	207
Medium maturity (3-7 years)	48	106	122	161	324	478	187
Long maturity (7-15 years)	73	100	117	165	337	572	191
All maturities (0-15 years)	60	104	123	168	335	521	191
N	121	2589	4117	4860	2654	738	15079
			September 2009 to June 2010				
Short maturity (0-3 years)	259	326	358	636	1009	1398	570
Medium maturity (3-7 years)	189	324	419	550	1045	1294	589
Long maturity (7-15 years)		368	419	555	1006	1554	600
All maturities (0-15 years)	245	334	400	576	1027	1388	586

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table II
Sample Characterization

Using panel data between January 2004 and June 2009, this table presents simple averages by year of the variables considered in the empirical model. N corresponds to the total number of observations for each year.

Variables	2004	2005	2006	2007	2008	2009	2004-2009
Bond spreads (OAS)	169.53	156.36	146.81	158.88	406.22	574.75	271.87
Years to maturity	8.51	7.59	6.68	5.86	5.18	4.65	6.17
Issue size	19.39	19.29	19.17	19.20	19.29	19.32	19.26
Coupon rate	683.06	663.68	646.93	640.12	643.72	635.87	648.92
Equity volatility	27.07	25.89	27.96	27.90	44.98	72.92	37.48
Credit rating	13.60	13.55	13.94	14.33	14.24	14.22	14.05
Operating income to sales	0.17	0.18	0.17	0.15	0.12	0.08	0.14
ST debt to total debt	0.18	0.21	0.24	0.27	0.27	0.25	0.25
Total debt to asset	0.31	0.31	0.33	0.34	0.33	0.33	0.33
Size	9.78	9.86	10.15	10.47	10.59	10.58	10.31
Sovereign credit rating	19.29	19.03	19.07	19.10	19.14	19.10	19.11
Gamma measure	31.35	25.34	22.87	39.20	131.60	173.54	73.87
Noise measure	2.07	1.93	1.58	2.45	9.37	10.19	4.91
Supranational AAA spread	19.20	17.07	17.27	29.82	84.19	92.74	49.06
On/off-the-run U.S. Treasury spread	24.57	8.46	3.94	10.31	41.51	55.44	23.81
KfW spread				16.02	49.17	61.85	38.96

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

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Table III
Corporate Bond Spreads and Rollover Risk

This table presents estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for bond- and time-fixed effects. The panel data consist of 667 corporate bonds covering the period from January 2004 to June 2009. Robust standard errors are clustered at the bond level and shown in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Investment Grade Bonds					Speculative Grade Bonds				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Years to maturity	-65.844***	-50.564***	-217.070***	-101.972***	-250.743***	-97.652***	-91.752***	-307.159***	-170.485***	-331.546***
	(6.883)	(5.103)	(20.615)	(10.414)	(25.074)	(14.602)	(12.774)	(37.561)	(20.564)	(49.922)
Equity volatility	2.172***	2.125***	2.217***	2.209***	2.383***	3.634***	3.528***	3.629***	3.604***	4.080***
	(0.453)	(0.447)	(0.460)	(0.463)	(0.518)	(0.897)	(0.900)	(0.888)	(0.938)	(1.114)
Credit rating	-13.166**	-15.144***	-8.893	-7.374	-16.697*	-55.154***	-55.788***	-42.333***	-31.742*	-49.981
	(5.414)	(5.742)	(5.457)	(6.461)	(9.740)	(16.354)	(16.357)	(15.793)	(18.134)	(38.929)
Operating income to sales	-35.341	-36.953	-35.399	-39.158	-31.026	-377.988***	-374.221***	-378.291***	-385.013***	-519.772***
	(29.206)	(30.068)	(28.613)	(29.200)	(33.616)	(80.500)	(79.790)	(81.515)	(85.354)	(111.785)
ST debt to total debt	36.162	52.863*	31.555	40.663	87.500	-177.886*	-198.808**	-191.975**	-251.085**	-348.944**
	(26.942)	(29.086)	(26.144)	(30.733)	(67.570)	(97.030)	(96.002)	(89.832)	(104.890)	(143.250)
Total debt to asset	68.023	62.146	59.499	64.494	-12.133	-38.592	-40.610	-41.546	-72.443	-464.630**
	(89.808)	(92.517)	(90.944)	(103.449)	(206.759)	(144.024)	(144.700)	(141.773)	(152.352)	(219.497)
Size	-15.896	-15.631	-18.025	-21.416	-44.401	21.677	18.589	25.012	27.735	15.689
	(21.581)	(21.861)	(21.819)	(25.046)	(43.534)	(43.161)	(43.138)	(43.732)	(49.551)	(106.706)
Sovereign credit rating	-15.798	-12.757	-18.747*	-24.369*	-63.446*	-22.948**	-23.700**	-16.060	-31.958***	-62.921**
	(11.258)	(11.159)	(11.319)	(13.204)	(32.399)	(10.898)	(11.211)	(11.533)	(12.253)	(29.192)
Credit rating x Gamma	-0.271***					-0.381***				
	(0.040)					(0.099)				
ST debt to total debt x Gamma	0.953***					2.616***				
	(0.335)					(0.918)				
Credit rating x Noise		-3.647***					-5.924***			
		(0.528)					(1.511)			
ST debt to total debt x Noise		10.931**					45.553***			
		(4.787)					(13.963)			
Credit rating x On/Off-the-run-Treasury spread			-0.952***					-1.577***		
			(0.139)					(0.314)		
ST debt to total debt x On/Off-the-run-Treasury spread			3.151***					7.677***		
			(1.159)					(2.749)		
Credit rating x Supranational AAA spread				-0.563***					-0.969***	
				(0.080)					(0.189)	
ST debt to total debt x Supranational AAA spread				1.812***					4.824***	
				(0.677)					(1.782)	
Credit rating x KfW spread					-1.021***					-1.088***
					(0.134)					(0.390)
ST debt to total debt x KfW spread					3.053***					10.673***
					(1.105)					(2.915)
Observations	16691	16691	16563	15239	9685	4684	4684	4652	4319	2592
Number of bonds	497	497	497	493	469	170	170	170	166	151
R-squared within	0.624	0.618	0.624	0.624	0.598	0.732	0.734	0.734	0.737	0.738
R-squared between	0.097	0.171	0.006	0.022	0.001	0.311	0.328	0.026	0.150	0.034
R-squared overall	0.281	0.359	0.024	0.158	0.037	0.462	0.475	0.099	0.298	0.125
F	64.41	62.49	64.18	72.75	72.83	56.10	57.52	58.20	60.30	47.44

Table IV
Alternative Subsamples

This table presents estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for bond- and time-fixed effects. The panel data consist of 667 corporate bonds covering the period from January 2004 to June 2009. Robust standard errors are clustered at the bond level and shown in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Banks	Non-Banks	Bonds without embedded options	Bonds with embedded options	Quarterly data
	(1)	(2)	(3)	(4)	(5)
Years to maturity	-111.116***	-83.461***	-92.544***	-90.932***	-120.257***
	(15.120)	(5.775)	(9.038)	(6.183)	(6.462)
Equity volatility	0.408	3.713***	2.617***	2.869***	2.482***
	(0.497)	(0.589)	(0.589)	(0.595)	(0.372)
Credit rating	0.132	-33.045***	-8.384	-33.937***	-20.444***
	(8.233)	(8.530)	(10.970)	(9.634)	(6.408)
Operating income to sales	-163.019***	-64.445**	-33.951	-137.526**	-60.700**
	(56.028)	(29.454)	(26.135)	(57.904)	(24.376)
ST debt to total debt	-45.269	-83.442**	-58.918	53.258	4.169
	(49.888)	(41.585)	(48.035)	(41.574)	(30.998)
Total debt to asset	112.767	-6.990	225.628*	98.184	226.947***
	(77.764)	(97.095)	(132.311)	(86.233)	(63.499)
Size	-81.832*	-10.100	27.324	-16.826	11.997
	(46.571)	(20.669)	(43.608)	(20.491)	(19.119)
Sovereign credit rating	-60.056*	-20.098***	-25.186***	-31.125	-26.284***
	(31.758)	(7.766)	(9.056)	(20.077)	(8.120)
Credit rating x Gamma	-0.375***	-0.394***	-0.443***	-0.383***	-0.498***
	(0.064)	(0.025)	(0.040)	(0.030)	(0.031)
ST debt to total debt x Gamma	1.289***	3.090***	1.177***	1.852***	1.856***
	(0.476)	(0.601)	(0.426)	(0.476)	(0.331)
Observations	4099	17276	9010	12365	7304
Number of bonds	165	446	280	331	611
R-squared within	0.702	0.684	0.646	0.705	0.701
R-squared between	0.231	0.377	0.207	0.340	0.167
R-squared overall	0.263	0.440	0.329	0.405	0.286
F	250.7	48.04	57.77	47.80	90.39

DOI: 10.2870/41878

Table V
Alternative Nonlinear Effects of Market Illiquidity

This table presents estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for bond- and time-fixed effects. The panel data consist of 667 corporate bonds covering the period from January 2004 to June 2009. Robust standard errors are clustered at the bond level and shown in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Investment Grade Bonds	Speculative Grade Bonds
	(1)	(2)
Years to maturity	-67.296***	-74.006***
	(8.666)	(20.853)
Equity volatility	1.449*	2.891**
	(0.756)	(1.334)
Credit rating	-13.292**	-51.454***
	(6.100)	(15.850)
Operating income to sales	-38.084	-360.384***
	(28.783)	(77.573)
ST debt to total debt	16.728	-143.477
	(25.173)	(93.183)
Total debt to asset	7.774	-113.274
	(104.874)	(172.995)
Size	-8.951	17.163
	(21.884)	(41.560)
Sovereign credit rating	-17.037	-23.512**
	(11.496)	(11.301)
Credit rating x Gamma	-0.232***	-0.478***
	(0.032)	(0.128)
ST debt to total debt x Gamma	0.949***	2.424**
	(0.349)	(0.934)
Equity volatility x Gamma	0.005	0.006
	(0.004)	(0.008)
Total debt to asset x Gamma	0.498	0.788
	(0.458)	(1.100)
Size x Gamma	-0.083*	0.283
	(0.048)	(0.181)
Years to maturity x Gamma	-0.021	-0.064
	(0.019)	(0.064)
Observations	16691	4684
Number of bonds	497	170
R-squared within	0.627	0.735
R-squared between	0.0795	0.375
R-squared overall	0.266	0.515
F	61.57	62.49

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table VI
Market Illiquidity versus Credit Deterioration and Financial Instability

This table presents estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for bond- and time-fixed effects. The panel data consist of 667 corporate bonds covering the period from January 2004 to June 2009. Robust standard errors are clustered at the bond level and shown in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Investment Grade Bonds		Speculative Grade Bonds	
	(1)	(2)	(3)	(4)
Years to maturity	-65.852***	-65.686***	-99.838***	-99.515***
	(6.881)	(6.896)	(14.708)	(14.781)
Equity volatility	2.214***	2.242***	3.589***	3.582***
	(0.457)	(0.461)	(0.895)	(0.895)
Credit rating	-13.473**	-13.684**	-55.554***	-55.828***
	(5.394)	(5.387)	(16.291)	(16.266)
Operating income to sales	-35.114	-35.567	-366.194***	-368.452***
	(29.218)	(29.216)	(82.381)	(82.340)
ST debt to total debt	34.971	33.224	-193.242**	-195.224**
	(27.027)	(27.078)	(97.578)	(98.296)
Total debt to asset	62.380	55.454	-25.027	-27.073
	(89.404)	(89.629)	(144.402)	(144.099)
Size	-16.205	-16.320	20.244	21.237
	(21.618)	(21.668)	(43.296)	(43.279)
Sovereign credit rating	-15.443	-15.096	-23.391**	-23.322**
	(11.285)	(11.311)	(10.992)	(10.948)
Credit rating x Gamma	-0.271***	-0.271***	-0.382***	-0.382***
	(0.040)	(0.040)	(0.099)	(0.099)
ST debt to total debt x Gamma	0.952***	0.952***	2.754***	2.719***
	(0.335)	(0.335)	(0.910)	(0.910)
ST debt to total debt x Libor-OIS spread residual	0.338*		1.539*	
	(0.192)		(0.817)	
ST debt to total debt x TED spread residual		0.303**		0.733
		(0.137)		(0.593)
Observations	16691	16691	4684	4684
Number of bonds	497	497	170	170
R-squared within	0.624	0.624	0.733	0.732
R-squared between	0.0985	0.100	0.307	0.307
R-squared overall	0.281	0.283	0.456	0.457
F	63.21	63.36	57.25	56.44

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

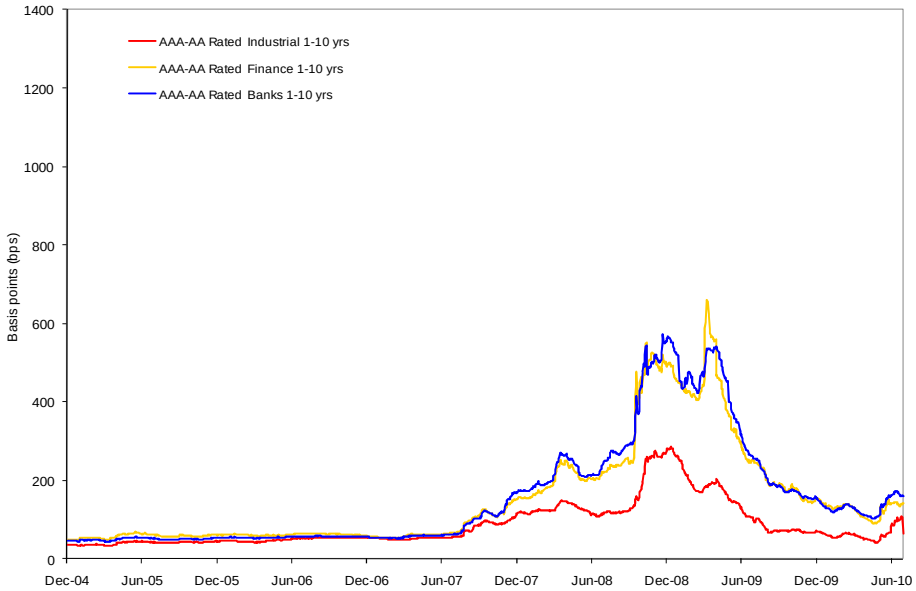
Table VII
IV-GMM Estimation

This table presents estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for industry- and time-fixed effects. The panel data consist of 667 corporate bonds covering the period from January 2004 to June 2009. Each equation is estimated by IV-GMM. Short-term debt to total debt and rollover losses are instrumented with the firm-fixed effects from a regression of short-term debt to total debt on firm dummies and with the three- and six-month lags of the interaction between debt market illiquidity and the same firm-fixed effects. These firm-fixed effects are estimated from the period between January 2004 and December 2006. All independent variables are lagged three months. Robust standard errors are clustered at the bond level and shown in parentheses below each coefficient estimate. P-values for the Hansen's J test of over-identifying restrictions are reported. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Investment Grade Bonds	Speculative Grade Bonds
	(1)	(2)
Years to maturity	5.933***	14.931***
	(0.663)	(3.493)
Issue size	-4.615***	136.657***
	(0.952)	(14.789)
Coupon rate	0.093***	0.345***
	(0.014)	(0.058)
Equity volatility	2.462***	3.156***
	(0.228)	(0.559)
Credit rating	-5.473***	-65.048***
	(1.702)	(7.718)
Operating income to sales	-25.607*	-153.838***
	(15.329)	(44.513)
ST debt to total debt	64.534**	459.090***
	(27.297)	(137.088)
Total debt to asset	28.186**	226.337***
	(12.157)	(76.556)
Size	1.742	2.850
	(1.998)	(7.875)
Sovereign credit rating	-9.201***	14.464***
	(1.027)	(2.790)
Credit rating x Gamma	-0.226***	-0.250***
	(0.022)	(0.068)
ST debt to total debt x Gamma	1.267***	2.469***
	(0.351)	(0.920)
Observations	8956	2264
Adjusted R-squared	0.520	0.531
F test of exduded instruments	1551 / 447	113 / 68
Partial R-squared of exduded instruments	0.4589 / 0.2327	0.1578 / 0.1317
Hansen's J test p-value	0.462	0.306

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Panel A: U.S. dollar-denominated AAA-AA corporate debt



Panel B: U.S. dollar-denominated A-BBB corporate debt

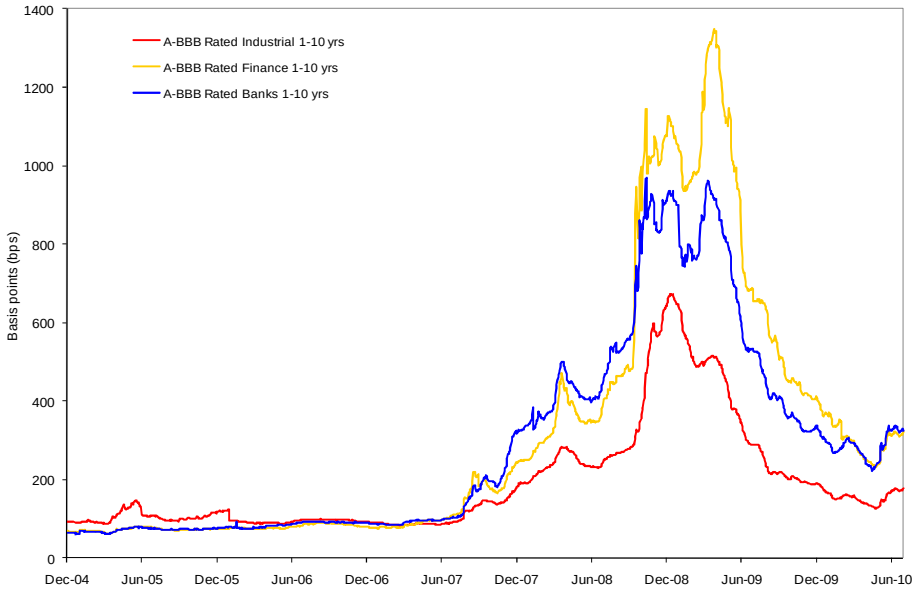


Figure 1. Bank of America (BofA) Merrill Lynch Corporate Option-Adjusted Spread Indexes by Sector. Panel A of the figure depicts option-adjusted spread indexes of the U.S. dollar-denominated AAA-AA corporate debt publicly issued by corporations in the industrial, financial, and banking sectors. Panel B of the figure shows option-adjusted spread indexes of the U.S. dollar-denominated A-BBB corporate debt publicly issued by corporations in the industrial, financial, and banking sectors.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

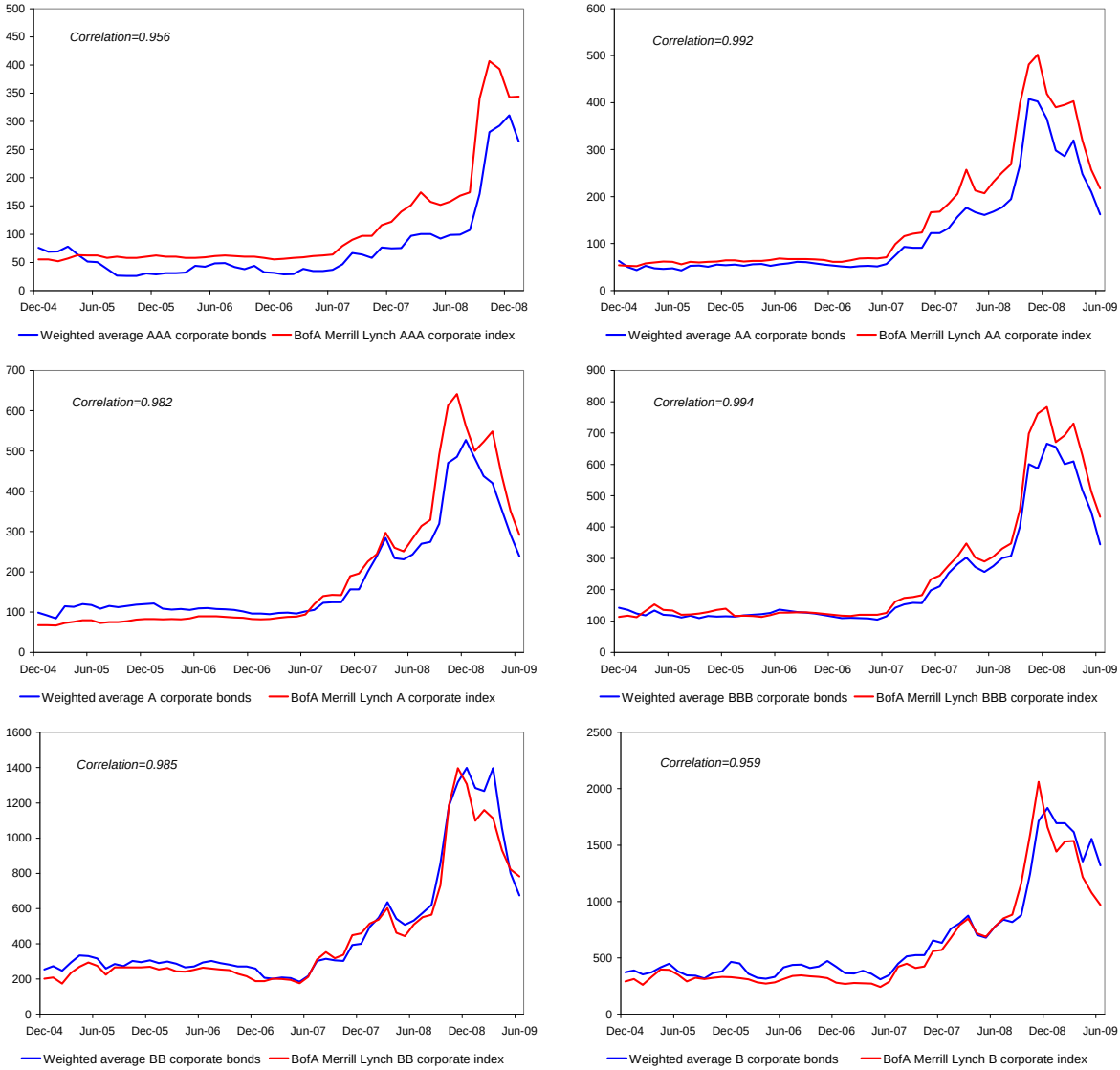


Figure 2. Corporate Option-Adjusted Spreads. For each credit rating category, the panels in the figure depict the weighted average OASs calculated from the bond-level data used in this paper along with the Bank of America (BofA) Merrill Lynch OAS indexes. The AAA, AA, A, and BBB U.S. Corporate Indexes are a subset of the BofA Merrill Lynch U.S. Corporate Index, which include securities with an investment-grade rating and an investment-grade-rated country of risk. The BB and B U.S. High Yield Indexes are a subset of the BofA Merrill Lynch U.S. High Yield Index, which includes securities with a lower than investment-grade rating and an investment-grade-rated country of risk. Simple correlations between both indexes are reported for each credit rating category.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

CHAPTER 2

SOVEREIGN CEILINGS 'LITE'? THE IMPACT OF SOVEREIGN RATINGS ON CORPORATE RATINGS

Until the late 1990s, credit rating agencies never granted credit ratings to private companies that were higher than the ratings given to the debt issues by the sovereign, a policy that was termed the 'sovereign ceiling.' Standard & Poor's (S&P) started to relax this policy somewhat in 1997. The rating agencies first relaxed the policy in three dollarized economies: Argentina, Panama, and Uruguay. The reasoning was that in a highly (or fully) dollarized country, the government would be less likely to impose capital controls in the event of a sovereign default, and the credit rating of private issuers would not be affected by a potential sovereign default (Standard & Poor's (1997)). Although the credit rating agencies have gradually relaxed the sovereign ceiling policy and some private-sector borrowers receive credit ratings higher than those of the governments of their countries, the rating agencies recognize that the sovereign rating is still an important consideration in determining private ratings.

In this paper, we use a new dataset of corporate and sovereign credit ratings over the period of 1995-2009 to investigate whether a *de facto* sovereign ceiling policy has persisted since the relaxation of the previous policy in 1997. Our results are consistent with a sovereign ceiling 'lite' policy or ceiling that is not an absolute constraint, but a limitation that tends to decrease corporate ratings when these ratings are above the sovereign rating. We find a positive impact of sovereign credit ratings on corporate credit ratings, which is significant even after controlling for firm-level financial indicators of creditworthiness and macroeconomic conditions in the country. This effect is robust to

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different samples, to including firm- and time-fixed effects and to instrumenting for sovereign credit ratings. The influence of sovereign credit ratings on corporate credit ratings is stronger for firms in emerging economies and firms producing non-tradable goods that have cash flows in domestic currency. In addition, we report a non-parametric analysis and a powerful set of asymmetries and non-linear effects that are consistent with a sovereign ceiling lite policy.

Although a sovereign ceiling policy usually has a greater effect on firms in emerging economies where the sovereign rating is relatively low, the debt crisis in Europe has also highlighted the importance of considering sovereign risk as a significant factor in the pricing of corporate debt in advanced economies that are under distress.[14] Therefore, a sovereign ceiling constitutes a potential source of negative externality for the private sector in both emerging economies and distressed advanced economies. In the short term, governments need to be aware of the potential effects of rating announcements on private debt. In the medium term, they should factor these externalities into their decisions on external borrowing.

Despite a rich body of research on the link between sovereign and corporate credit risk, there has not been an explicit test for the existence of a *de facto* sovereign ceiling policy in credit ratings for the period post-1997. Using a dataset covering the period from 1990 to 1999, Ferri, Lui and Majnoni (2001) find a significant positive correlation between the changes in private credit ratings and the changes in sovereign credit ratings, although they do not control for firm-level and country-level variables. This correlation is higher in emerging economies and for rating downgrades. Ferri and Liu

[14] On January 13, 2012, S&P lowered the long-term ratings on Cyprus (from BBB to BB+), Italy (from A to BBB+), Portugal (from BBB- to BB), Spain (from AA- to A), Austria (from AAA to AA+), France (from AAA to AA+), Malta (from A to A-), Slovakia (from A+ to A), and Slovenia (from AA- to A+). Thus, the sovereign ratings of several advanced European countries moved to levels at which the sovereign ceiling may imply a significant burden on the private sector.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

(2002) show, using credit ratings for the period from 1997 to 1999, that sovereign ratings have a significant effect on private ratings in emerging market economies even after controlling for firm-level financial indicators, which were specified in a weighted average aggregate form. However, this indicator of creditworthiness at the firm level was generally statistically insignificant. Durbin and Ng (2005) explore whether a sovereign ceiling policy was reflected in corporate bond spreads. They find that, in many cases, corporate bonds traded at spreads that were narrower than those of the sovereign and that this happened more often for firms with high export earnings or an ownership link with either a foreign corporation or the home government. Cavallo and Valenzuela (2010) show that sovereign bond spreads in emerging economies increase corporate bond spreads, even after controlling for firm-level performance indicators and country-specific macroeconomic conditions.

This paper contributes to the literature on corporate credit ratings in two ways. First, it explicitly explores the sovereign ceiling policy using credit rating data that cover a long period after the relaxation of this policy by S&P in 1997. This paper presents a nonparametric test and a set of asymmetries and non-linear effects on the sovereign-private rating correlation, which help to characterize the influence of the sovereign ceiling in a lite version. Second, this paper comprehensively examines the determinants of corporate credit ratings. It simultaneously controls for firm-level financial variables and macroeconomic conditions in the country when estimating the impact of sovereign ratings on private firms' ratings. In contrast to Ferri and Liu (2002), firm-level variables are included in the regressions individually rather than as an aggregate to use the explanatory power of these variables more efficiently.

Because of the role of credit ratings in financial markets, knowledge of the main determinants of corporate credit ratings, including the sovereign ceiling policy, has important implications for

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

investors and firm managers. Credit ratings are one of the main determinants of corporate bond spreads (Campbell and Taksler (2003) and Covitz and Downing (2007)). In addition, credit ratings categories impose different costs on the firm. For example, as Kisgen (2006) argues, 'A firm's rating affects operations of the firms, access to other financial markets such as commercial paper, disclosure requirement for bonds…, and bond covenants, which can contain ratings triggers whereby a ratings change can result in changes in coupon rates or a forced repurchase of the bond.' Finally, credit ratings matter in a number of other contexts. For example, some regulations concerning investments in bonds depend upon credit ratings and affect not only the pool of international investors that firms can access but also their cost of debt capital (Kisgen and Strahan (2010)).

This paper is organized as follows: Section I provides some background information about sovereign and corporate credit ratings and the sovereign ceiling. Section II describes our dataset. Section III reports the empirical methodology and our main results. Section IV concludes this paper.

I. Sovereign and Corporate Credit Ratings and the Sovereign Ceiling

There are at least three reasons to expect a positive correlation between sovereign and corporate credit ratings. The first reason relates to the country-specific macro-level vulnerabilities that make both forms of debt risky. Exposure to large external shocks (via terms of trade, for example) is one such source of vulnerability. Increasing the variance of profits for firms and the tax receipts for governments with higher macro-level volatility increases the probability of default. Note that this macro-level vulnerability introduces an unconditional positive correlation between the probabilities

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

of default by a government and a private corporation. However, despite this correlation, there is no reason why private debt should be riskier on average than government debt.

The second reason for a positive correlation is the 'spillover' effect from the sovereign default to private debtors. A sovereign in default may undertake measures that directly affect the private sector's ability to repay. Inflationary financing and tax increases are both examples of spillovers. Sovereign default may also have a direct impact on private-sector solvency and liquidity by generating a credit crunch in both domestic and international financial markets as agents exposed to sovereign debt react to the direct effects of the sovereign default on their net worth.[15] This spillover effect generates a positive correlation between the probabilities of sovereign and corporate default; firms in countries with riskier governments, ceteris paribus, should be more risky than their counterparts in countries with safer government debt. Despite this correlation, there is no reason a priori why a firm may not have a lower default risk and, hence, a better rating than its sovereign.

The final reason for the positive correlation between corporate and sovereign credit ratings is the imposition of direct capital controls or other administrative measures that effectively prevent private borrowers from servicing their external obligations when the sovereign reaches a situation of default or near-default. If the sovereign defaults, the private sector must also default on the external debt because it cannot access the dollars it needs and/or get them out of the country. Imposing these restrictions implies that private debt will always be riskier than sovereign debt.[16]

[15] The issue of contagion 'via Wall Street' has received considerable attention recently (Calvo (2005)). Recent research on institutional determinants of contagion confirms this view by linking financial contagion to characteristics of developed economy markets and investors. Private-sector borrowing may be contaminated by a sovereign default if they both belong to a particular asset class (Rigobon (2001)) or share a set of overexposed mutual funds (Borensztein and Gelos (2003)).

[16] Prati et al. (2012) find a strong positive effect of capital account liberalization on corporate credit ratings. They also find that liberalizing the capital account benefits significantly more those firms with more limited foreign currency access, namely, those producing non-tradables.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

The first and second reasons imply a positive *correlation* between corporate and sovereign credit ratings, but no sovereign ceiling. On average, firms in countries with riskier governments will be riskier, but there is no reason why they could not have a higher rating than the government does. The third reason, by contrast, provides a rationale for a sovereign ceiling.

Figure 1 illustrates the sovereign ceiling and the relationship between corporate and sovereign credit ratings granted by S&P. These ratings are mapped onto twenty-one numerical categories, with 21 corresponding to the highest rating (AAA) and 1 to the lowest rating (D) (Appendix 1). Whereas Figure 1a shows that corporate ratings never exceeded the sovereign level until 1996, Figure 1b shows that a small number of corporate credit ratings started to pierce the sovereign ceiling after 1997. In the period after 1997, 81 percent of the corporations received a rating lower than the sovereign, 13 percent received the same rating and just 6 percent received a rating higher than the sovereign. Figures 1c and 1d divide the sample into emerging and developed economies, respectively. It is clear from these figures that a sovereign ceiling is much more significant for firms in emerging economies where the sovereign ratings are relatively low. The fraction of firms that received the same rating as their sovereign was larger in emerging countries than in developed countries.

[Insert Figure 1 about here.]

II. Sample Characteristics and Data Description

This section presents the data that we use to explore whether a sovereign ceiling policy persisted since S&P relaxed this policy in 1997. The dataset contains corporate and sovereign credit ratings

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

and accounting variables for every publicly traded non-financial firm with an S&P foreign-currency credit rating available from Bloomberg in June 2005 (except firms that were located in countries with a time–invariant sovereign foreign-currency credit rating of AAA during the whole period under study).[17] The following countries were excluded from the dataset: Austria, Germany, France, the United Kingdom, Liechtenstein, Luxemburg, the Netherlands, Norway and the United States. Table I presents the descriptive statistics for the main variables that we used in this work.

[Insert Table I about here.]

To reduce the potential for errors in data coding, we eliminated all firm/year observations where accounting variables exceeded the sample mean by more than six standard deviations (about one percent of the total sample). The final sample is an unbalanced panel of 478 non-financial corporations from 29 countries, including 14 developed and 15 emerging economies.[18] Thus, our dataset is representative of the whole universe of publicly traded firms that are located in less developed economies and issued corporate bonds. Our sample size is similar to those of other studies using comprehensive corporate credit rating data (e.g., Ferri, Liu and Majnoni (2001)).

A. Foreign-Currency Corporate Credit Ratings

Our main dependent variable is the foreign-currency long-term corporate credit rating issued by S&P. We only use these ratings to avoid inconsistencies that arise from different types of debt

[17] The dataset used in this paper was constructed in June 2005 and updated in June 2009. Therefore, it does not include firms that were granted a credit rating for the first time after June 2005. To reduce concerns with sample selection bias, we replicate all our specifications using firm fixed effects.

[18] The countries included in our final sample are: Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, the Czech Republic, Denmark, Finland, Hungary, India, Indonesia, Ireland, Italy, Japan, Lithuania, Malaysia, Mexico, New Zealand, Peru, the Philippines, Poland, Portugal, Spain, Sweden, Taiwan and Thailand.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

issues. Moreover, international debt issues tend to be denominated in foreign currency (Eichengreen, Hausmann, and Panizza (2001); Gozzi et al. (2012)).

Standard and Poor's (2001a) defines a Foreign Currency Credit Rating as 'A current opinion of a obligor's overall capacity to meet its foreign-currency-denominated financial obligations. It may take the form of either an issuer or an issue credit rating. As in the case of local currency credit ratings, a foreign currency credit opinion on Standard and Poor's global scale is based on the obligor's individual credit characteristics, including the influence of country or economic risk factors. However, unlike local currency ratings, a foreign currency credit rating includes transfer and other risks related to sovereign actions that may directly affect access to the foreign exchange needed for timely servicing of the rated obligation. Transfer and other direct sovereign risks addressed in such ratings include the likelihood of foreign-exchange control and the imposition of other restrictions on the repayment of foreign debt.'

To calculate a quantitative measure for corporate and sovereign credit ratings, we followed the existing literature and mapped the credit rating categories into twenty-one numerical values, where the values 21 and 1 corresponded to the highest and lowest ratings, respectively (Cantor and Packer (1996) and Reinhart (2002)). An explanation of this scale and descriptions of the rating categories are presented in Appendix 1.

B. Foreign-Currency Sovereign Credit Ratings

Our main independent variable is the foreign-currency long-term sovereign credit rating issued by S&P, which is an assessment of the probability of default by government debt. The credit rating agencies define government default as (i) a missed payment or (ii) a distressed debt exchange that implies a diminished financial obligation by the government. The credit rating agencies state that

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

they rate a sovereign bond by evaluating a large number of economic and political factors over a 5-year horizon and making qualitative and quantitative assessments. However, Cantor and Packer (1996) find that over 90 percent of the variance of sovereign ratings assigned by Moody's and S&P is explained by eight variables: per-capita income, GDP growth, inflation, fiscal balance, current account balance, debt-to-export ratio, an indicator variable of an advanced economy, and an indicator variable of default since 1970.

C. Other Corporate Credit Rating Determinants

To control for variables that could affect corporate credit ratings directly, we include a broad set of variables at the firm and macro levels. The choice of our firm-level variables is based mainly on the literature about discriminant analysis and the determinants of corporate credit ratings (Altman (2000)). We consider variables that capture the profitability of a firm (the ratio of earnings before interest and taxes (EBIT) to assets and the ratio of retained earnings to assets), leverage (ratio of equity to capital), liquidity (ratio of working capital to assets), interest coverage (ratio of EBIT to interest expense) and size (total assets).[19]

As discussed above, sovereign and corporate credit ratings correlate when macroeconomic variables increase the risk of both public and private debt. Omitting these variables would bias the estimate of the influence of a sovereign ceiling on private ratings. To address this issue, our baseline specification also includes a set of macroeconomic variables that have been shown in the literature to correlate with sovereign credit ratings. Macroeconomic controls include per-capita GDP, GDP growth, growth volatility, inflation, and current accounts. In unreported regressions, we also include

[19] For the size of the firms, we deflate asset data to 2000 values using December-to-December changes in the consumer price index (CPI), then convert them to U.S. dollars using the market exchange rate for December 2000.

the ratio of external debt to exports. Although our results remain unchanged when this ratio is included, we do not consider it in our basic regressions because our sample size drops considerably. Appendix 2 describes these variables and their their sources in detail.

III. EMPIRICAL ANALYSIS AND MAIN RESULTS

A. Nonparametric Analysis

The frequency distribution of corporate credit ratings provides a direct window into the question of whether a *de facto* sovereign ceiling policy has persisted even after its relaxation in 1997. This approach is inspired by nonparametric tests of whether the constraints are binding. The premise is that if no sovereign ceiling is binding, then the corporate ratings should have a smooth distribution. In contrast, a cluster of corporate ratings around the sovereign rating would be evidence of a binding sovereign ceiling. Figure 2 plots the histogram of the gap between corporate and sovereign ratings in the period from 1998 to 2009, after the relaxation of the sovereign ceiling policy. The large spike at 0 is evidence of clustering around the sovereign rating and provides preliminary evidence of a persistent sovereign ceiling effect.

B. Baseline Regressions

We begin our regression analysis by measuring the effect of the sovereign credit ratings on the corporate credit ratings when appropriately controlling for other factors that can have a direct effect on corporate ratings. Our baseline specification posits that the credit rating Rtg_{isct} of firm *i* belonging to industry *s* in country *c* during period *t* is given by

$$\mathrm{Rtg}_{\mathrm{isct}} = \mathbf{A}_{\mathrm{s}} + \mathbf{B}_{\mathbf{c}} + \mathbf{C}_{\mathrm{t}} + \lambda \mathrm{X}_{\mathrm{it}} + \gamma \mathrm{Z}_{\mathrm{ct}} + \delta \mathrm{Sov\_Rtg}_{\mathrm{ct}} + \mu_{\mathrm{isct}} \qquad (1)$$

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

where the subscript "*isct*" refers to firm *i*, industry *s*, country *c*, and time *t*. $\mathbf{A}_s$, $\mathbf{B}_c$ and $\mathbf{C}_t$ are vectors of industry, country and year dummy variables, respectively, that account for industry, country and year fixed effects. X_{it} are firm-level determinants of idiosyncratic risk, Z_{ct} are country-level macroeconomic variables that affect the risk level of all firms in the economy, and Sov_Rtg_{ct} is the sovereign credit rating. The parameter of interest in this estimation is δ.

Our baseline specification includes industry fixed effects to control for average industry-level characteristics, country fixed effects to control for average country-level characteristics, and time fixed effects to control for global factors such as global financial crises or the world business cycle. We also estimate all of our specifications including firm fixed effects, instead of industry and country fixed effects, to control for average firm-level characteristics. Thus, these firm fixed effects control for endogenity that arises from time-invariant firm heterogeneity.

Table II reports the results from estimating our baseline regressions by ordinary least squares with clustering of the errors by country and year. Column 1 reports the results from our regression with industry, country and year fixed effects. Column 2 reports the results from our regression with firm and year fixed effects. We find a significant positive correlation between sovereign and corporate credit ratings. The estimated coefficient implies that increasing the sovereign rating by two or three units has the effect of increasing the average corporate rating by one unit.

[Insert Table II about here.]

As suggested by Figures 1c and 1d, a sovereign ceiling seems to be much more of an issue for firms in emerging economies than for firms in advanced economies because sovereign credit ratings

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

for emerging economies are much lower than the ratings for advanced economies. In columns 3 and 4 of Table II, we test this argument by re-estimating our two previous specifications with an interaction term between the sovereign rating and a dummy variable that takes a value equal to one for advanced economies. We find that the effect of sovereign credit ratings is stronger in emerging countries than in advanced countries. This result is consistent with previous results by Ferri, Liu and Majnoni (2001), although our specification is more complete in the sense that we control for firm- and country-level variables.

We also expect firms whose output is oriented to the domestic market to be more sensitive to sovereign risk as the macroeconomic impact of sovereign default may take a higher toll on them. Furthermore, these firms are more vulnerable to the imposition of capital controls because they do not have direct foreign currency earnings. To explore this hypothesis, columns 5 and 6 augment our baseline regressions with an interaction term between the sovereign rating and a dummy variable that takes the value one for firms in the tradable sector. The significant negative coefficient for the interaction term suggests that, as expected, the firms in the non-tradable sector are more sensitive to sovereign default risk than the firms in the tradable sector are.

In all our regressions, most control variables have strong explanatory power in the expected directions. Among the firm-level variables, there is a positive correlation between the private ratings and the two measures of profitability (retained earnings and current earnings), debt coverage (EBIT to interest expense) and size. Our measure of leverage (equity to assets) is positively correlated with ratings. With regard to the macroeconomic variables, we find that inflation and GDP volatility have negative impacts on corporate credit ratings. Corporations in countries with higher rates of growth of the GDP receive better ratings, and corporations from countries with higher current account deficits receive lower average ratings. Finally, the significant negative coefficients for per-capita

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

GDP confirm that more firms with ratings below the sovereign rating are present in high-income countries (recall Figures 1c and 1d).

C. Sovereign and Corporate Credit Ratings' Correlation over Time

As a consequence of the abolishment of the sovereign ceiling policy by S&P in 1997, we should observe a decline in the magnitude of the correlation between the sovereign credit ratings and the corporate credit ratings over time. In Table III, we test whether the data exhibit this decline by re-estimating our baseline specifications and adding interaction terms between the sovereign rating and year dummies post-1995. The positive coefficient for the sovereign rating variable and the negative coefficients for the interaction terms suggest that there has been a decline in the influence of the sovereign ratings on the corporate ones. The increasing absolute values of the coefficients associated with the interaction terms indicate that the relaxation of the sovereign ceiling policy has been gradual. Note that most of the coefficients for the interaction terms in column 1 are statistically significant at standard levels of confidence. Column 2 reports a similar pattern, although the results are not as significant. In Figure 3, we display the total magnitude of the correlation between sovereign ratings and corporate ratings by year. The figure shows that both specifications (i.e., the one including industry and country fixed effects and the one including firm fixed effects) indicate that the sovereign ceiling policy has been relaxed over time. Although the figure suggests a declining trend in the correlation between sovereign and corporate ratings, there appears to be an inflexion point in this trend approximately 2006. This reversal may be caused by the risks associated with the financial crisis of 2007 to 2009, which increased the probability of a possible reversal in the process of capital liberalization around the world.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

[Insert Table III about here.]

[Insert Figure 3 about here.]

D. Asymmetries

This section presents a set of asymmetries, which are consistent with our sovereign ceiling lite hypothesis. We conduct this analysis using data over the period of 1998-2009, which is after the relaxation of the sovereign ceiling policy. The results offer additional evidence to support our sovereign ceiling lite hypothesis for a ceiling that does not impose an absolute constraint but tends to reduce corporate ratings, when these ratings are above the sovereign rating.

If the impact of the sovereign ratings on the private ratings is caused by spillovers or common macroeconomic effects, then this effect should be symmetric. Upgrades and downgrades should have the same effects and affect firms in all credit rating categories in a similar way. Table IV contains a set of asymmetries that address these issues. We begin by analyzing whether the impact of the sovereign ratings on corporate ratings is different for upgrades and downgrades of the sovereign. We estimate our baseline specification in first differences and allow for differentiated effects of the changes in sovereign rating that are positive and negative. In addition to sovereign rating changes, we introduce a dummy variable that equals 1 in the presence of a sovereign credit rating upgrade. The negative coefficient on the interaction term in column 1 of Table IV indicates that the effect is indeed larger for sovereign downgrades and smaller for sovereign upgrades.

[Insert Table IV about here.]

Column 2 allows the effect of changes in the sovereign rating to differ between those firms that hit the ceiling (had ratings equal to that of the sovereign) and those that did not in the previous period. Spillovers or common macro effects imply that all firms should be affected equally by the sovereign rating change, but the estimated coefficients suggest that this is not the case. Sovereign rating changes have a larger effect on firms whose ratings are the same as the sovereign rating.

Column 3 reports a regression that simultaneously incorporates all of the asymmetries and allows for differential impacts in advanced and emerging economies. The negative coefficient for the interaction between the sovereign rating changes and the dummy variable for developed economies is consistent with the fact that a sovereign ceiling policy is a much less significant issue for firms in advanced economies, where the sovereign ratings are relatively high. Finally, columns 4, 5 and 6 replicate our previous specifications using firm fixed effects instead of industry and country fixed effects. Overall, our main results remain qualitatively unchanged.

E. Non-linear Effect

Figure 5 attempts to define the non-linear effect of a sovereign ceiling policy by using a systematic framework. First, we used the values of the parameters that were estimated for firms in a sub-sample of countries with the AAA sovereign rating (these firms are thus unconstrained by sovereign ceilings), and we forecast the ratings for the firms in non-AAA countries. If a sovereign ceiling does not exist, there should be a one-to-one relationship between the actual and the predicted corporate ratings (solid line). A strict sovereign ceiling would create a constraint where no firm is rated above the sovereign (dotted line). The shaded area depicts a sovereign ceiling lite situation. To implement this framework, we estimated the following equation for the period of 1998–2009:

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

$$Rtg_{isct} = \alpha + \beta_0 \widehat{Rtg}_{isct} + \beta_1 (\widehat{Rtg}_{isct} - Sov\_Rtg_{ct}) I[\widehat{Rtg}_{isct} \geq Sov\_Rtg_{ct}] + \beta_2 I[\widehat{Rtg}_{isct} \geq Sov\_Rtg_{ct}] + \mu_{it} \quad (2)$$

where $\widehat{Rtg}_{isct}$ is the predicted corporate rating using the coefficients obtained for firms in triple-A countries (no sovereign ceiling). If there is no sovereign ceiling effect, then β_0 would equal 1 and β_1 would equal 0. If there is an absolute sovereign ceiling, then $\beta_0 = 1$, $\beta_1 = -1$. If there is a sovereign ceiling lite, then $\beta_0 = 1$ and $-1 < \beta_1 < 0$. The last term in the equation is included to ensure that the estimate of β_1 is not biased. Table V reports the coefficients and robust standard errors estimated from equation (2). The results are broadly compatible with a sovereign ceiling lite hypothesis.

[Insert Figure 5 about here.]

[Insert Table V about here.]

IV. ADDITIONAL ROBUSTNESS CHECKS

This section performs a set of specifications to check that our baseline results are not driven by potential endogenity. Table VI reports different estimation methodologies and samples to evaluate the specification that was reported earlier in Table II (column 1). Column 1 of Table VI replicates our baseline specification using the lagged firm-level variables and the lag of the sovereign credit rating. Column 2 reports our baseline specification using a two-stage least-squares (2SLS) estimator where the average sovereign rating for all countries with a particular degree of development (i.e., developed economies or emerging economies) is used as an instrument for the sovereign rating in a

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

particular country. [20] This instrument is likely to be more strongly correlated with the sovereign rating than the cross-country variables, such as colonial or legal origins and geographic variables as it exhibit some variation over time. Moreover, the average sovereign credit rating is more likely to be exogenous than the lagged sovereign credit ratings are because the latter rely on exogeneity over time that is unlikely to exist. In columns 3 and 4, we divide our sample into subsets of companies with asset sizes below and above the median to check whether our results are driven by reverse causality. The argument for this test is as follows: if firms reach a situation of default, this situation could affect the revenues of the government (or expenditures during a bailout) and increase the probability of sovereign default. Under the premise that larger firms are more likely than smaller firms to affect the fiscal situation of the government, we divide our sample according to the sizes of the firms. Overall, the results in Table VI show that sovereign credit ratings have a positive and highly significant impact on corporate credit ratings and that this result is unlikely to be driven by endogenity.

V. Conclusions

This paper shows that a *de facto* sovereign ceiling policy on credit ratings has persisted since it was relaxed in the late 1990s. A powerful set of analyses suggests the presence of a sovereign ceiling lite policy that is not an absolute constraint, but a limitation that tends to reduce corporate ratings, when these ratings are above the sovereign rating. Although a sovereign ceiling is much more of an issue in emerging economies that tend to have a low sovereign rating, in view of the recent debt crises in Europe a sovereign ceiling policy may also have important implications for advanced

[20] This instrument is similar in spirit to the instrument that was used by Honig (2008). Honig used an instrument for capital account liberalization with the average level of openness of other countries to capture the 'fad' element in financial liberalization.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

economies under distress. In the short term, governments need to be aware of the potential effects of ratings announcements; in the medium term, they should factor externalities into their decisions about external borrowing. Although the economic impact of sovereign credit risk on corporate credit risk through a sovereign ceiling channel seems to be important, prior empirical studies have not included an explicit evaluation of this channel.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Appendix 1

Scale of Standard and Poor's Foreign Currency Debt Rating

This table defines the credit rating categories. The credit ratings categories are mapped into 21 numerical values; the 21 and 1 correspond to the highest (AAA) and the default (SD/D) categories, respectively.

Interpretation	Rating	Assigned value
INVESTMENT-GRADE RATINGS		
Highest quality	AAA	21
High quality	AA+	20
	AA	19
	AA-	18
Strong payment capacity	A+	17
	A	16
	A-	15
Adequate payment capacity	BBB+	14
	BBB	13
	BBB-	12
NONINVESTMENT-GRADE RATINGS		
Likely to fulfill obligations, ongoing	BB+	11
	BB	10
	BB-	9
High-risk obligation	B+	8
	B	7
	B-	6
Currently vulnerable nonpayment obligation	CCC+	5
	CCC	4
	CCC-	3
Highly vulnerable to nonpayment	CC/C	2
Default	SD/D	1

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Appendix 2
Description of Variables

This table describes the variables that are used in our analysis. The names, definitions, units and sources of the variables are listed.

Variable Name	Definition	Unit of Measurement	Data Sources
Sovereign Rating	Ratings assigned as of June 15 by S&P	AAA=21;…….D=1	S&P
Corporate Rating	Ratings assigned as of June 15 by S&P	AAA=21;…….D=1	S&P
EBIT/Assets	EBIT to total assets	Percent	Bloomberg
Retained earnings/Assets	Retained earnings to total assets	Percent	Bloomberg
Working Capital/Assets	Working capital to total assets	Percent	Bloomberg
Equity/Capital	Equity to capital	Percent	Bloomberg
EBIT/Interest expense	EBIT to interest expense	Percent (in natural logarithms)	Bloomberg
Size Assets	Total assets	Millions of US$ of 2000 is deflated by the CPI (in natural logarithms)	Bloomberg
Inflation	Annual consumer price inflation rate	Percent	WDI
Current Account	Current account relative to GDP	Percent	WDI
Growth GDP	Annual real GDP growth	Percent	WDI
GDP per capita	GDP per capita	Millions of US$ of 2000 (in natural logarithms)	WDI
Volatility GDP	Variance 10 year GDP growth	Variance 5 years	WDI
Advanced	IMF classification	Advanced=1 ; Developing=0	IMF

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

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Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

Table I
Descriptive Statistics

This table presents descriptive statistics for the variables in the empirical model. The sample is split into developed and emerging market economies.

Variables	Developed economies	Emerging economies
Sovereign ratings	19.54	11.80
Corporate ratings	14.17	10.55
EBIT/Assets	7.39	9.83
EBIT/Interest expense	7.58	7.31
Retained earnings/Assets	19.23	18.76
Working Capital/Assets	7.61	5.14
Equity/Capital	55.17	54.25
Size	4.21	3.35
Number of corporations	389	89
Number of countries	14	15
Observations	2809	877

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table II
Sovereign and Corporate Credit Ratings

This table reports the parameter estimates for the impact of sovereign credit ratings on corporate credit ratings, controlling for firm-level performance indicators and macroeconomic conditions. The sample covers the period of 1995-2009 for 14 developed economies and 15 emerging-market economies. The labels, *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country-year groups, are given in parentheses.

Corporate Rating	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EBIT/Assets	0.082***	0.037***	0.083***	0.043***	0.072***	0.036***
	(0.009)	(0.007)	(0.009)	(0.006)	(0.009)	(0.007)
EBIT/ Interest Expense	0.368***	0.221***	0.343***	0.142**	0.391***	0.199***
	(0.089)	(0.061)	(0.085)	(0.056)	(0.091)	(0.060)
Retained Earnings/Assets	0.027***	0.014***	0.027***	0.013***	0.027***	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Working Capital/Assets	-0.013***	0.012***	-0.014***	0.012**	-0.014***	0.012***
	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)	(0.005)
Equity/Capital	0.035***	0.022***	0.035***	0.022***	0.035***	0.022***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Size	0.943***	0.644***	0.953***	0.655***	0.946***	0.634***
	(0.059)	(0.091)	(0.059)	(0.089)	(0.059)	(0.091)
GDP per capita	-0.914***	-0.598*	-0.926***	-0.604**	-0.967***	-0.621*
	(0.289)	(0.355)	(0.270)	(0.300)	(0.275)	(0.346)
Inflation	-0.023*	-0.023*	-0.009	0.001	-0.026**	-0.023*
	(0.012)	(0.012)	(0.013)	(0.014)	(0.011)	(0.012)
Current Account/GDP	0.077***	0.062***	0.076***	0.059***	0.076***	0.062***
	(0.015)	(0.016)	(0.014)	(0.014)	(0.015)	(0.015)
Growth GDP	0.044*	0.074***	0.024	0.041*	0.038*	0.069***
	(0.023)	(0.026)	(0.022)	(0.022)	(0.021)	(0.025)
Volatility GDP	-1.987***	-2.228***	-1.597***	-1.522***	-1.984***	-2.224***
	(0.553)	(0.556)	(0.523)	(0.478)	(0.517)	(0.543)
Sovereign Rating	0.453***	0.311***	0.590***	0.552***	0.528***	0.417***
	(0.043)	(0.059)	(0.061)	(0.065)	(0.044)	(0.083)
Sovereign Rating x Advanced			-0.267***	-0.527***		
			(0.080)	(0.077)		
Sovereign Rating x Tradable					-0.144***	-0.215***
					(0.021)	(0.081)
Observations	3686	3686	3686	3686	3686	3686
R-squared	0.692	0.921	0.693	0.925	0.697	0.922
Firm Fixed Effects	NO	YES	NO	YES	NO	YES
Industry Fixed Effects	YES	NO	YES	NO	YES	NO
Country Fixed Effects	YES	NO	YES	NO	YES	NO
Time Fixed Effects	YES	YES	YES	YES	YES	YES

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Table III
Sovereign and Corporate Credit Ratings over Time

This table reports the parameter estimates for the impact of sovereign credit ratings on corporate credit ratings, controlling for firm-level performance indicators and macroeconomic conditions. The sample covers the period of 1995-2009 for 14 developed economies and 15 emerging-market economies. The labels, *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country-year groups, are given in parentheses.

Corporate Rating	**(1)**	**(2)**
Sovereign Rating	0.542***	0.305***
	(0.072)	(0.074)
Sovereign Rating x 1(1996)	-0.076	-0.115
	(0.074)	(0.078)
Sovereign Rating x 1(1997)	-0.085	-0.077
	(0.082)	(0.070)
Sovereign Rating x 1(1998)	-0.088	-0.011
	(0.077)	(0.077)
Sovereign Rating x 1(1999)	-0.126*	-0.066
	(0.070)	(0.074)
Sovereign Rating x 1(2000)	-0.143*	-0.089
	(0.073)	(0.081)
Sovereign Rating x 1(2001)	-0.132*	-0.063
	(0.070)	(0.069)
Sovereign Rating x 1(2002)	-0.103	-0.011
	(0.082)	(0.081)
Sovereign Rating x 1(2003)	-0.132*	-0.034
	(0.070)	(0.066)
Sovereign Rating x 1(2004)	-0.157**	-0.014
	(0.073)	(0.071)
Sovereign Rating x 1(2005)	-0.180**	-0.044
	(0.076)	(0.074)
Sovereign Rating x 1(2006)	-0.257***	-0.133*
	(0.074)	(0.072)
Sovereign Rating x 1(2007)	-0.253***	-0.143**
	(0.075)	(0.072)
Sovereign Rating x 1(2008)	-0.250***	-0.136*
	(0.075)	(0.077)
Sovereign Rating x 1(2009)	-0.207***	-0.092
	(0.079)	(0.076)
Observations	3686	3686
R-squared	0.694	0.923
Firm Fixed Effects	NO	YES
Industry Fixed Effects	YES	NO
Country Fixed Effects	YES	NO
Time Fixed Effects	YES	YES

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Table IV
Asymmetries

This table reports the parameter estimates for the impact of sovereign credit changes on corporate credit rating changes, controlling for changes in macroeconomics and firm-level factors. The sample covers the period from 1997 to 2009. The labels, *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country-year groups, are given in parentheses.

ΔCredit Rating	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ΔSovereign Rating	0.657***	0.387***	0.721***	0.673***	0.391***	0.741***
	(0.179)	(0.125)	(0.163)	(0.197)	(0.140)	(0.169)
ΔSovereign Rating x 1(Sovereign Rating-Sovereign Rating(-1)>0)	-0.434**		-0.399***	-0.443**		-0.401***
	(0.195)		(0.143)	(0.212)		(0.149)
ΔSovereign Rating x 1(Credit Rating(-1)=Sovereign Rating(-1))		0.315*	0.232		0.340*	0.246
		(0.167)	(0.143)		(0.177)	(0.154)
ΔSovereign Rating x 1(Developed)			-0.424***			-0.474***
			(0.134)			(0.142)
Observations	3091	3091	3091	3091	3091	3091
R-squared	0.24	0.232	0.267	0.315	0.308	0.346
Firm Fixed Effects	NO	NO	NO	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	NO	NO	NO
Country Fixed Effects	YES	YES	YES	NO	NO	NO
Time Fixed Effects	YES	YES	YES	YES	YES	YES

Table V
Non-linear Specification of Sovereign Ceiling

This table reports the parameter estimates for equation (2). The sample covers the period from 1997 to 2009. The labels *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country-year groups, are given in parentheses.

Credit Rating	**(1)**
$\widehat{Rtg}_{isct}$	0.965***
	(0.03)
$(\widehat{Rtg}_{isct} - Sov\_Rtg_{ct})I[\widehat{Rtg}_{isct} \geq Sov\_Rtg_{ct}]$	-0.742***
	(0.05)
$I[\widehat{Rtg}_{isct} \geq Sov\_Rtg_{ct}]$	-0.760***
	(0.21)
Constant	0.38
	(0.44)
Observations	3546
R-squared	0.523

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

Table VI
Robustness Checks

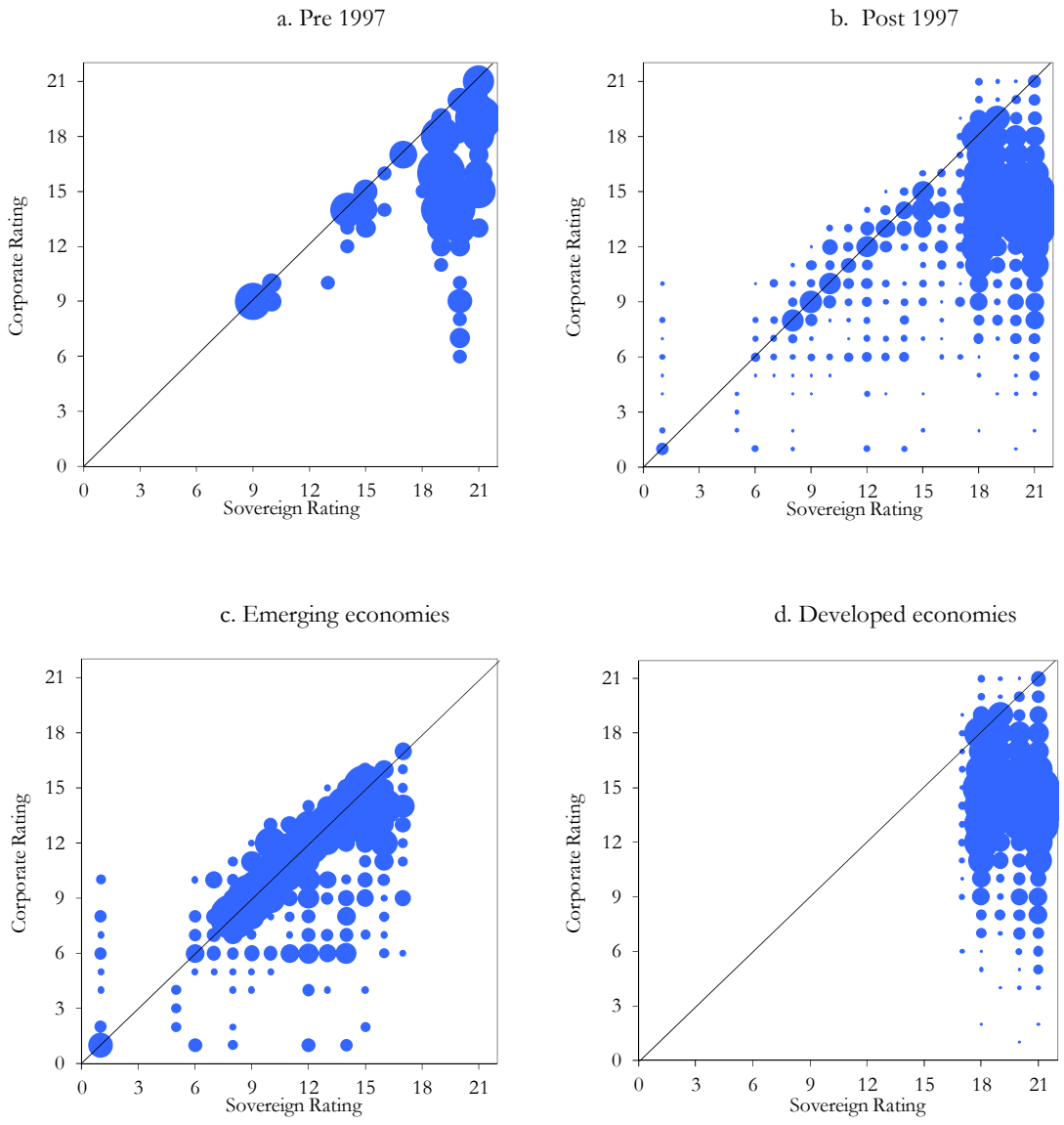
This table reports the parameter estimates of the impact of sovereign credit ratings on corporate credit ratings, controlling for firm-level, macroeconomic and global factors. Industry, country and year dummies are controlled. The sample covers the period of 1995-2009 for 14 developed economies and 15 emerging-market economies. The labels *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country-year groups, are given in parentheses.

Credit Rating	**(1)**	**(2)**	**(3)**	**(4)**
EBIT/Assets	0.095***	0.080***	0.072***	0.097***
	(0.011)	(0.009)	(0.011)	(0.015)
EBIT/ Interest Expense	0.374***	0.392***	0.333***	0.459***
	(0.104)	(0.095)	(0.077)	(0.121)
Retained Earnings/Assets	0.022***	0.027***	0.025***	0.037***
	(0.004)	(0.004)	(0.003)	(0.006)
Working Capital/Assets	-0.018***	-0.014***	-0.013***	-0.004
	(0.004)	(0.003)	(0.003)	(0.006)
Equity/Capital	0.037***	0.035***	0.035***	0.027***
	(0.004)	(0.004)	(0.005)	(0.004)
Size	0.926***	0.930***	1.185***	0.918***
	(0.064)	(0.060)	(0.104)	(0.088)
GDP per capita	-1.158**	-1.003***	0.107	-1.659***
	(0.488)	(0.266)	(0.381)	(0.402)
Inflation	-0.047***	-0.012	0.013	-0.057***
	(0.017)	(0.013)	(0.019)	(0.017)
Current Account/GDP	0.064***	0.081***	0.100***	0.061***
	(0.019)	(0.015)	(0.026)	(0.018)
Growth GDP	0.116***	0.041*	0.04	0.068**
	(0.033)	(0.022)	(0.035)	(0.028)
Volatility GDP	-1.145*	-1.528**	-2.759***	-0.512
	(0.641)	(0.608)	(0.762)	(0.643)
Sovereign Rating	0.371***	0.596***	0.519***	0.387***
	(0.048)	(0.104)	(0.071)	(0.050)
Observations	3180	3686	1708	1978
R-squared	0.684	0.690	0.703	0.707
Industry Fixed Effects	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Figure 1
Corporate and Sovereign Credit Ratings

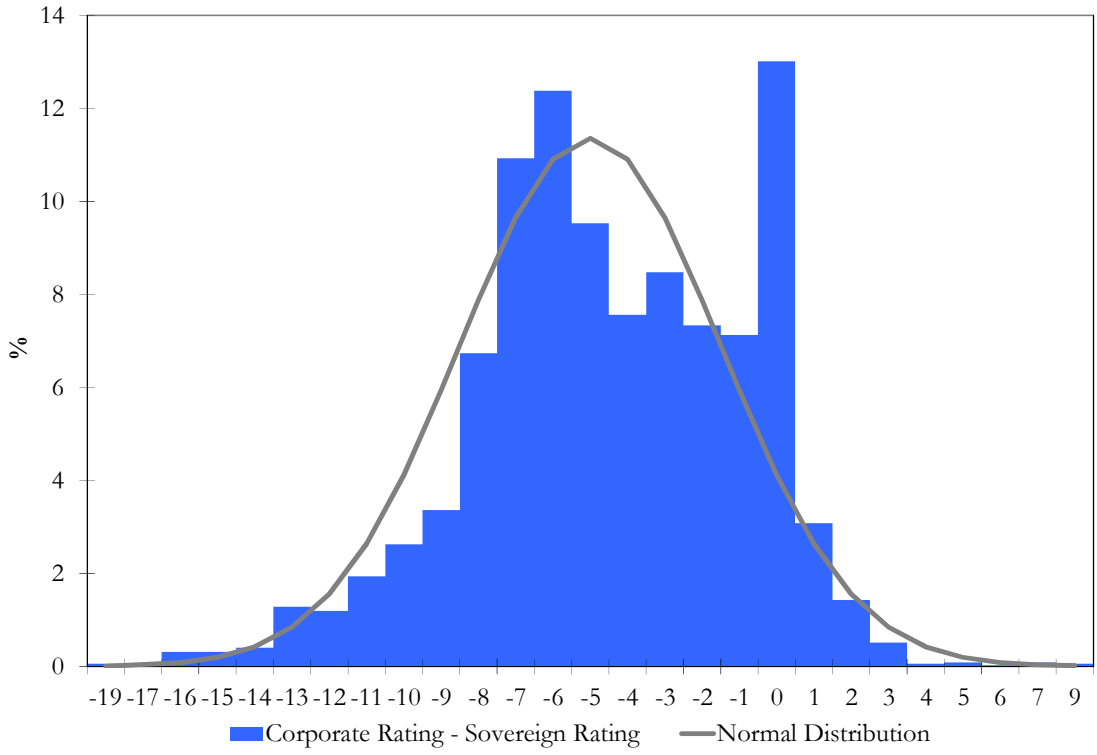
These figures show the relationship between corporate and sovereign credit ratings assigned by S&P. The credit rating categories are mapped onto twenty-one numerical values, where 21 corresponds to the highest rating (AAA) and 1 corresponds to the lowest rating (D). The size of each bubble represents the number of observations for each corporate-sovereign credit rating pair. Figures a and b correspond to the pre-1997 and post-1997 periods, respectively. Figures c and d correspond to emerging and developed economies, respectively.



Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Figure 2
Corporate and Sovereign Credit Rating Gap Distribution

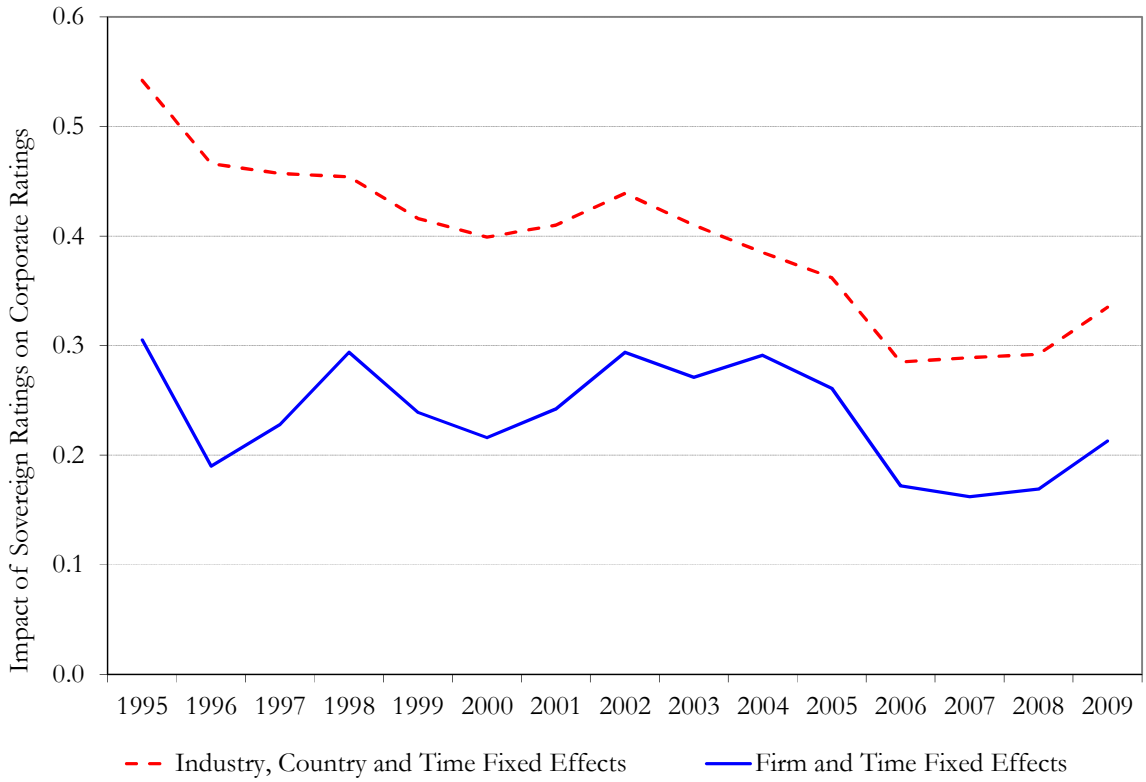
This figure shows the distribution of the gap between corporate and sovereign credit ratings for the period from 1998 to 2009.



Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Figure 3
Relaxation of the Sovereign Ceiling Policy

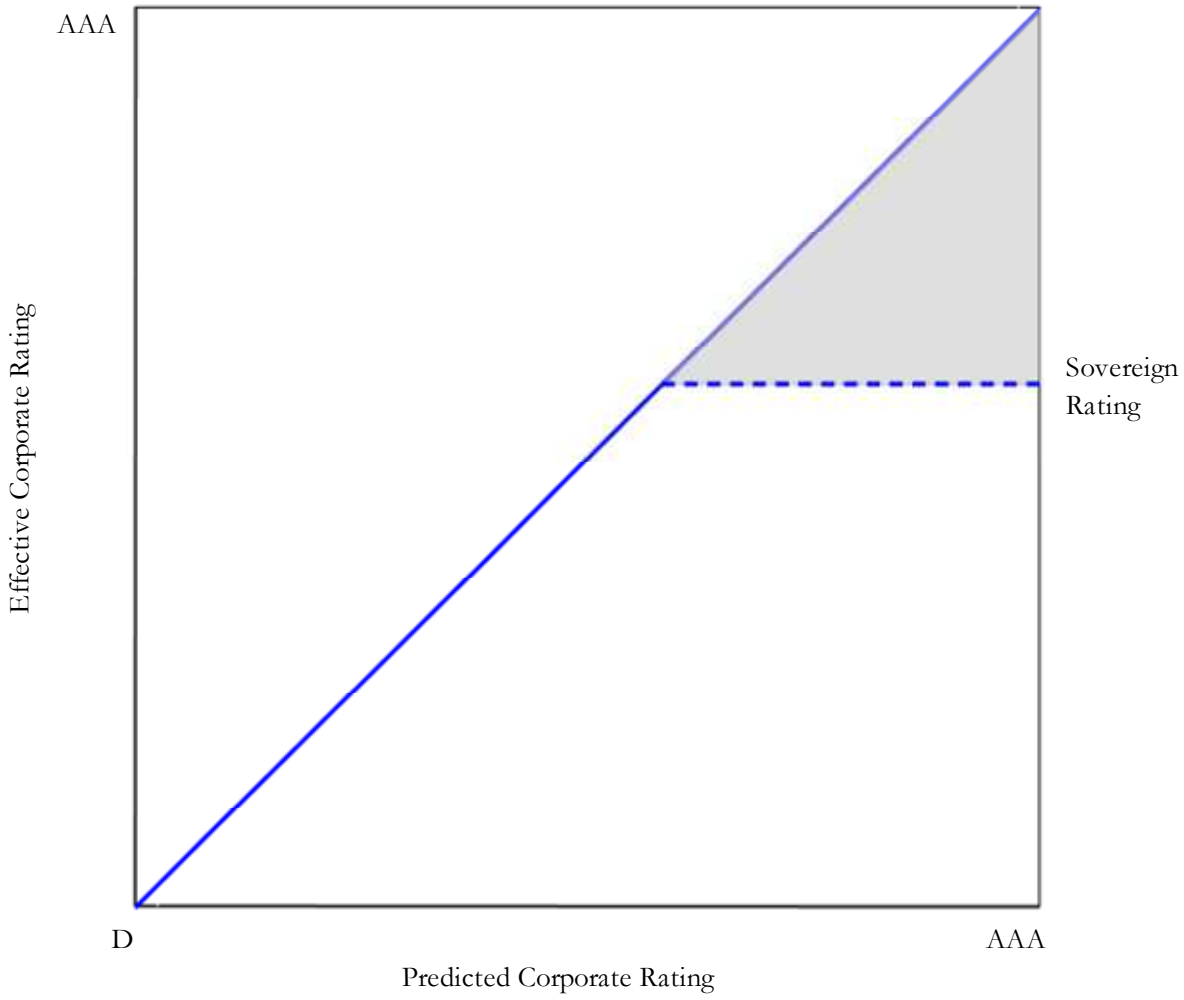
This figure shows the impact of sovereign credit ratings on corporate credit ratings since 1995. The blue and red lines correspond to the estimates obtained from the samples of emerging markets and developed economies, respectively.



Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Figure 5
Sovereign Ceiling

This figure shows the relationship between the effective corporate rating and the predicted corporate rating. The latter is obtained by using the coefficient that was estimated for corporations located in AAA countries, where firms are unconstrained by the sovereign ceiling. This relationship is represented by the solid line (no sovereign ceiling), the dotted line (strict sovereign ceiling at the inflection point), and the shaded area (sovereign ceiling lite).



Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

CHAPTER 3

CAPITAL ACCOUNT RESTRICTIONS AND THE COST OF DEBT CAPITAL FOR PRIVATE FIRMS

There exists a large body of research on the effects of financial openness. However, whether economies should liberalize their capital account transactions still remains an open question. While theory predicts a number of benefits from financial openness such as access to cheaper capital, portfolio diversification, consumption smoothing, emulation of foreign banks and institutions, and macro policy discipline (Frankel (2010)), results from empirical studies present arguments in favor and against capital account liberalization.

On the one hand, there are a number of empirical studies suggesting that capital account liberalizations are often associated with higher economic growth, investment, corporate credit ratings and equity prices, lower consumption growth volatility, and reduced financial constraints (Bekaert, Campbell, and Lundblad (2005, 2006, 2011), Henry (2000a, 2000b), Quinn and Toyota (2008), Forbes (2007), Prati et al (2011)). On the other hand, there are also a number of empirical studies suggesting that capital account restrictions make monetary policy more independent, alter the composition of capital flows toward longer maturities, reduce real exchange pressures, and reduce leverage and dependence on short-term debt (De Gregorio et al (2000), Gallego and Hernandez (2003), Reinhart and Smith (1998)).

Although the study of the impact of capital account restrictions on the pricing of corporate bonds in international markets has been ignored in prior empirical studies, it is a crucial area of research. According Gozzi, Levine, and Schmukler (2010), debt issues in public markets are a more important source of capital for firms than equity issues and debt

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markets are more internationalized than equity markets.[21] This paper contributes to the nascent micro-oriented literature on the effects of capital account liberalizations exploring the impact of capital account restrictions on corporate bond spreads. Since aggregate measures of capital account liberalization are likely to give a misleading picture, this paper investigates whether the impact of capital account restrictions is asymmetric across different capital account restrictions regimes (i.e., restrictions on inflows versus restrictions on outflows).

The paper's major finding is that capital account restrictions on inflows produce a significant increase of corporate bond spreads. This finding is consistent with the fact that firms residing in a country where restrictions on capital inflows are in place have fewer and/or more costly opportunities of raising capital and selling financial assets in both domestic and international markets, making these firms more vulnerable to shocks and more likely to default. The paper also presents some evidence that capital account restrictions on outflows tend to decrease corporate bond spreads. This result suggest that capital controls on outflows may decrease the vulnerability of a country to speculative attacks, which is consistent with the fact that capital controls on inflows represent primarily a crisis containment tool (Demirguc-Kunt and Serven (2009)). Finally, the paper shows that capital account liberalizations on inflows matter a great deal more during times of financial distress. The main results in this paper are statistically and economically significant, even after controlling for the standard determinants of corporate bond spreads. And, they are robust to including bond- and time-fixed effects and to instrumenting for capital account restrictions.

[21] In emerging market economies, the total amount raised through equity issues abroad represents 27.8% of the total amount raised through equity issues, while that the total amount raised through debt issues abroad represents 47.3% of the total amount raised through debt issues. In developed economies, the total amount raised through equity and debt issues abroad represents 7.8% and 34.7% respectively.

The remainder of the paper is organized as follows. Section I describes the sample characteristics and data description. Section II presents the main empirical results from the regression analysis. Section III demonstrates that the results are robust to control for endogeneity. Section IV concludes.

I. Sample Characteristics and Data Descriptions

For the purpose of this paper, I merge a new dataset on corporate bonds placed on international markets by developed and emerging market borrowers with a new dataset on capital account restrictions. The period under study is from Q1:2005 to Q2:2009. The dataset on corporate bonds builds on that used in Valenzuela (2011). It considers all fixed-rate bonds denominated in U.S. dollars available in Bloomberg by June 2009, with the exception of bonds issued by firms located in the U.S. or England. The measures on capital account restrictions used in this paper are adopted from the methodology introduced by Schindler (2009), which is based on information provided in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER).

To reduce potential errors in the coding of the data, I clean the data set in four ways. First, I eliminate the top and bottom 0.5% of the spreads from my analysis. Second, I drop the observations where any of the accounting variables exceed the sample mean by more than five standard deviations. Third, I do not consider the bonds issued in countries where the total number of observations was smaller than 30.[22] Fourth, I restrict the sample to bonds issued by firms with a S&P credit rating between AAA and B-. After the cleaning of

[22] The bonds eliminated in this cleaning of the data correspond to bonds issued in The Bahamas, China, and Hong Kong.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

the data, the final sample including all my control variables contains 4,706 bond-quarter observations.

A. Corporate Bond Spreads

The dependent variable is the corporate *option-adjusted spread* (OAS) from Bloomberg. The OAS is the constant spread over the underlying Treasury term structure across each path that make the theoretical value of the bond equal to the market price of the bond. When the OAS is measured over a U.S. Treasury security as in this case, it captures the credit spread, a liquidity premium, and any richness or cheapness of the bond after adjusting for the effects of any embedded options. The use of OAS is important given that corporate bonds in general contain embedded options.[23]

B. Capital Account Restrictions

Following Schindler (2009), this paper utilizes two measures of capital account liberalizations that allow us to identify the channels through which capital account restrictions affects corporate bond spreads. The first measure indicates capital account restrictions on inflows (KA_IN). This measure is the simple average of eight dummy variables indicating restrictions on capital account transactions that involucrate the sale or issue of financial assets abroad by residents and the purchase or issue of financial assets locally by nonresidents. The second measure indicates capital account restrictions on outflows (KA_OUT). This measure is the simple average of eight dummy variables indicating restrictions on capital account transactions that involucrate the sale or issuance of financial assets locally by nonresidents and the purchase or issue of financial assets abroad by

[23] Other studies using OASs are, for example, Becchetti et al. (2010), Cavallo and Valenzuela (2010), Huang and Kong (2003), and Pedrosa and Roll (1998).

residents. Appendix A presents the transaction categories that according to the AREAER may be subject to capital account restrictions. Appendix B presents the construction of the two measures of capital account restrictions used in this paper (i.e., KA_IN and KA_OUT).

C. Other Corporate Bond Spread Determinants

All the regressions control for the standard determinants of corporate bond spreads. The choice of the control variables is mainly based in structural credit risk models and in the empirical literature on the determinants of corporate bond spreads (Merton (1974), Collin-Dufresne et al. (2001)). At the bond level, I control for time to maturity, issue size and coupon rate. At the firm level, I control for corporate credit rating, equity volatility, operating income to sales, short-term debt to total debt, total debt to assets, and firm size.[24]

II. Regression Analysis

The central question of this study is to explore if capital account restrictions by direction of flows affect corporate bond spreads. Thus, my baseline specification is as follows:

$$\text{Bond Spread}_{bfct} = \alpha + \mathbf{A}_f + \mathbf{B}_t + \beta X_{bfct} + \delta Z_{fct} + \gamma KA\_IN_{ct} + \theta KA\_OUT_{ct} + \varepsilon_{bfct},$$

where the subscript *'bfct'* refers to bond *b*, firm *f*, country *c,* and time *t*. $\mathbf{A}_b$ and $\mathbf{B}_t$ are vectors of firm and time dummy variables that account for bond and time fixed effects. X_{bfct} is a set of bond-level variables, Z_{fct} is a set of firm-level variables and ε_{bfc} is the error term. The main parameters of interest are γ and θ.

[24] Although my main results are robust to the inclusion the pretax interest coverage, I exclude this variable in my baseline regression given that my sample size drops considerably when it is added.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

Table I presents the main results of my estimation of the baseline regression by ordinary least squares with the errors clustered by firm. The results in column 1 suggest that capital that capital account restrictions on inflows increase corporate bond spreads, whereas that capital that capital account restrictions on outflows do not have a significant effect on spreads. This result seems intuitive as firms residing in a country where capital account restrictions on inflows are in place have fewer or/and more costly opportunities of raising capital and selling financial assets in both domestic and international markets. This would make more difficult and/or costly for these firms to obtain the dollars needed to pay maturing international debt, making these firms more vulnerable to shocks and more likely to default.

[Insert Table I about here.]

Since financial, macro and political-reforms usually are part of an entire package of structural reforms, it is possible that capital account liberalizations capture the effect of other structural reforms happening simultaneously. For example, countries may liberalize capital inflows at the same time as they deregulate the domestic financial system or they liberalize the current account. Columns 2 and 3 augment my baseline regression with a set of variables that control for other structural reforms or effects that may happen simultaneously to the capital account liberalization. Following Bekaert, Campbell, and Lundblad (2011), I consider credit to GDP, trade to GDP, political risk, and sovereign credit rating to control by other financial, macro, and political reforms respectively. I also consider the economic growth rate and the GDP per capita income to control for growth opportunities and economic

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

development in the country. The results remain unchanged once I control for other structural reforms and sovereign credit rating.

III. Endogeneity

Although bond fixed effects are likely to alleviate some endogeneity concerns, they do not deal effectively with endogeneity associated with time-varying firm characteristics. Therefore, the previous results only partially address the issue of causality. If capital account restriction decisions are based on time-varying unobservable factors, a better approach to address endogeneity is to estimate instrumental variable regression. Table II presents the results of my baseline specification using an IV two-stage least square (2SLS) estimator to allow for potential endogeneity. I instrument capital account restrictions on inflows and outflows with the absolute value of the latitude of the country and the exchange rate black market premium measured for the 1980s. All independent variables are lagged one year to reduce potential endogeneity concerns associated with these variables. Since the instruments used in this paper are constant within a country, in these estimations, I include industry fixed-effects instead of firm fixed effects.

[Insert Table II about here.]

The latitude of the country captures the geographical location that is likely to influence the likelihood of capital account liberalizations. This instrument is based on the observation that economies characterized by high rates of disease and poor agriculture development have a tendency to establish political institutions that restrict economic openness so that the elite

can exploit the most vulnerable sectors of the population (Acemoglu et al (2001), Easterly and Levine (2002)).

The past exchange rate black market premium captures an historical relationship between capital controls and exchange rate regimes. Thus, the exchange rate black market premium for the 1980s is used as an instrument for the exogenous variation in the use of capital restrictions during 2005-2009, a period in which "black market" exchange rates have practically vanished (Shleifer (2009)). This instrument is based on the observation that economies with pegged exchange rate, and thus with higher exchange rate black market premium, are less likely to liberalize their capital account as capital mobility increases the difficulty to operating a currency peg.

Table II presents the first and second stages from the IV two-stage least square (2SLS) estimator. The results from the second-stage (column 1) suggest that capital account restrictions on inflows increase corporate bond spreads, whereas restrictions on outflows reduce them. Therefore, the paper's major finding seems to be robust to correcting for endogeneity problems. Whereas the coefficient associated with capital account restrictions on inflows remains practically unchanged around 300 basis points, the coefficient associated with restrictions on inflows become larger and significant. The results from the first-stage (columns 2 and 3) are in line with the economic justification of our instruments. That is, countries with a higher exchange rate black market premium during the 1980s are significantly more likely to have capital account restrictions on place, whereas countries closer to the poles are significantly less likely to have capital account restrictions on place. The R-squared of excluded instruments and the F-test suggest that my excluded instruments are highly correlated with capital account restrictions on inflows and outflows after netting out the effects of all other exogenous variables.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

IV. Corporate Bond Spreads around Periods of Financial Distress

If capital account restrictions on inflows reduce the firms' financing sources, one would expect that, during periods of financial distress, firms operating in countries where capital account restrictions are in place will face relatively deeper problems accessing to capital, and a larger increase in corporate bond spreads. Therefore, capital account restrictions should be relatively more important when market illiquidity and financial stability worsen. Table III presents the results of testing for this possibility by including a number of interaction terms. Column 1 adds the interactions of KA_IN and KA_OUT with the Gamma measure, which is a measure of market illiquidity introduced by Bao, Pan and Wang (2011).[25] Column 2 adds the interactions of KA_IN and KA_OUT with the VIX index, which is a measure of the implied volatility of the S&P500 index options. Column 3 adds all the interaction terms simultaneously. Both debt market illiquidity and the VIX index have been used as standard determinants of corporate bond spreads.

[Insert Table III about here.]

The positive and significant coefficients on *"KA_IN x Gamma measure"* and *"KA_IN x VIX"* suggest that capital account restrictions on inflows matter a great deal more during times of financial distress.

[25] The Gamma measure is the negative of the autocovariance of bond prices changes. In account that transitory price movements produce negatively serially correlated price changes, the Gamma measure create a meaningful measure of debt market illiquidity that captures the impact of illiquidity on prices. This paper uses the aggregated Gamma measure that is obtained aggregating the Gamma measure across individual bonds. This measure is taken from Bao, Pan and Wang (2011), who construct it using information on the U.S. secondary corporate bond markets from the TRACE dataset.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

V. Conclusions

This paper shows that capital account restrictions have a significant effect on corporate bond spreads. The paper's major finding is that capital account restrictions on inflows significantly increase corporate bond spreads. This result is consistent with the fact that firms residing in a country with restrictions on capital inflows have fewer and/or more costly opportunities of raising capital and selling financial assets in both domestic and international markets, making these firms more vulnerable to shocks and more likely to default. This effect is significant even after controlling for the standard determinants of corporate bond spreads and is robust to control for potential endogeneity. Since debt issues in public markets are a more important source of capital for firms than equity issues and debt markets are more internationalized than equity markets, the study of the impact of capital account restrictions on the pricing of corporate bonds in international markets is particularly important.

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

Appendix A
Types of Capital Transactions Possibly Subject to Restrictions

Inflows	Outflows
Shares or other securities of a participating nature	
Purchase locally by nonresidents (PLBN)	Sale or issue locally by nonresidents (SILN)
Sale or issue abroad by residents (SIAR)	Purchase abroad by residents (PABR)
Money market instruments	
Purchase locally by nonresidents (PLBN)	Sale or issue locally by nonresidents (SILN)
Sale or issue abroad by residents (SIAR)	Purchase abroad by residents (PABR)
Bonds or other debt securities	
Purchase locally by nonresidents (PLBN)	Sale or issue locally by nonresidents (SILN)
Sale or issue abroad by residents (SIAR)	Purchase abroad by residents (PABR)
Collective investment securities	
Purchase locally by nonresidents (PLBN)	Sale or issue locally by nonresidents (SILN)
Sale or issue abroad by residents (SIAR)	Purchase abroad by residents (PABR)

Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute
DOI: 10.2870/41878

DOI: 10.2870/41878

Appendix B

$$KA\_IN = \frac{(SIAR_{share} + SIAR_{bond} + SIAR_{money\ \ market} + SIAR_{collective\ \ investment} + PLBN_{share} + PLBN_{bond} + PLBN_{money\ \ market} + PLBN_{collective\ \ investment})}{8}$$

$$KA\_OUT = \frac{(SILN_{share} + SILN_{bond} + SILN_{money\ \ market} + SILN_{collective\ \ investment} + PABR_{share} + PABR_{bond} + PABR_{money\ \ market} + PABR_{collective\ \ investment})}{8}$$

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Valenzuela, Patricio (2012), Essays on the Cost of Debt Capital for Private Firms
European University Institute DOI: 10.2870/41878

Table I

Corporate Bond Spreads, Capital Account Restrictions and Market Illiquidity

This table reports estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. All regressions control for bond and time fixed effects. The panel data consists of 181 firms covering the period running from Q1:2004 to Q2:2009. Robust standard errors, clustered at the bond level, are shown in parentheses below each coefficient estimate. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)
Bond Characteristc			
Years to maturity	0.931	0.954	0.955
	(1.291)	(1.267)	(1.265)
Issue size	7.212	6.550	6.544
	(7.113)	(6.411)	(6.396)
Coupon rate	0.049	0.058	0.058
	(0.043)	(0.040)	(0.040)
Firm Specific			
Equity volatility	4.297***	3.968***	3.967***
	(0.912)	(0.905)	(0.906)
Credit rating	-62.514***	-57.480***	-57.852***
	(14.682)	(14.723)	(15.362)
Operating income to sales	-185.606*	-131.062	-130.785
	(94.408)	(97.473)	(97.816)
ST debt to total debt	249.580***	244.986***	244.222***
	(74.904)	(72.803)	(72.585)
Total debt to asset	-42.857	48.307	46.459
	(144.237)	(137.395)	(138.008)
Size	-25.456	-14.198	-13.663
	(35.437)	(35.180)	(35.434)
Capital Account Restrictions			
Capital account restrictions on inflows (KA_IN)	335.122***	322.396***	324.840***
	(107.713)	(102.520)	(97.438)
Capital account restrictions on outflows (KA_OUT)	-35.964	-33.656	-33.845
	(31.797)	(28.956)	(29.195)
Country Risk			
Private credit to GDP		-93.707	-95.037
		(66.052)	(65.595)
Trade		-1.426*	-1.428*
		(0.845)	(0.848)
Political risk		-3.120	-3.253
		(4.232)	(4.103)
Growth		-7.354*	-7.405*
		(4.045)	(4.069)
GDP per capita		8.034	8.598
		(9.989)	(9.074)
Sovereign credit rating			2.766
			(13.374)
Observations	4706	4644	4644
Number of firms	181	179	179
R-squared within	0.644	0.652	0.652
R-squared between	0.687	0.621	0.617
R-squared overall	0.615	0.546	0.548
F	21.54	25.83	26.22

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Table II
Other Capital Account Restrictions and Structural Reforms

This table reports estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. The period under study runs from January 2005 to June 2009. Robust standard errors are in parentheses ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

	Second-stage	First-stage	First-stage
		Restrictions on inflows	Restrictions on outflows
	(1)	(2)	(3)
Bond Characteristc			
Years to maturity	2.917*	0.008***	0.013***
	(1.619)	(0.001)	(0.002)
Issue size	-2.074	-0.002	-0.012**
	(3.791)	(0.004)	(0.005)
Coupon rate	0.166***	0.000***	-.000
	(0.031)	(0.000)	(0.000)
Firm Specific			
Equity volatility	2.279***	-0.000	0.000
	(0.432)	(0.000)	(0.000)
Credit rating	-35.265***	-0.009***	-0.010***
	(2.425)	(0.002)	(0.003)
Operating income to sales	-333.882***	0.211***	0.152***
	(34.874)	(0.027)	(0.034)
ST debt to total debt	119.375***	0.067**	0.431***
	(29.067)	(0.031)	(0.038)
Total debt to asset	4.789	-0.120***	-0.095**
	(35.772)	(0.037)	(0.046)
Size	-7.762**	-0.008**	0.013***
	(3.753)	(0.004)	(0.004)
Capital Account Restrictions			
Capital account restrictions on inflows (KA_IN)	264.749**		
	(128.552)		
Capital account restrictions on outflows (KA_OUT)	-107.776**		
	(51.437)		
Instruments			
Exchange rate black market premium for the 1980s		0.3743***	0.098*
		(0.048)	(0.060)
Absolute value of the latitude of the country		-0.311***	-1.017***
		(0.020)	(0.025)
Observations	3780	3780	3780
Centered R-squared	0.624	0.252	0.4745
Unentered R-squared	0.8108	0.491	0.631
Partial R-squared of excluded instruments		0.131	0.3787
F-test		281.28	1141.46

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Table III
Corporate Bond Spreads and Capital Account Restrictions by Asset Category

This table reports estimates from a panel regression of corporate option-adjusted spreads against the variables listed below. The period under study runs from January 2005 to June 2009. Robust standard errors are in parentheses ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)
Bond Characteristc			
Years to maturity	0.789	0.667	0.667
	(1.249)	(1.240)	(1.242)
Issue size	7.131	7.134	7.114
	(6.972)	(6.839)	(6.856)
Coupon rate	0.053	0.056	0.056
	(0.043)	(0.043)	(0.043)
Firm Specific			
Equity volatility	4.637***	4.734***	4.761***
	(0.875)	(0.871)	(0.867)
Credit rating	-62.877***	-63.594***	-63.455***
	(14.221)	(13.710)	(13.774)
Operating income to sales	-186.588**	-188.760*	-188.140**
	(94.450)	(95.919)	(95.336)
ST debt to total debt	249.248***	242.825***	244.612***
	(72.467)	(72.267)	(71.962)
Total debt to asset	-66.907	-65.644	-70.005
	(145.738)	(149.217)	(149.175)
Size	-19.749	-15.665	-16.189
	(35.002)	(36.835)	(36.766)
Capital Account Restrictions			
Capital account restrictions on inflows (KA_IN)	243.518***	83.258	101.849
	(77.356)	(96.066)	(88.078)
Capital account restrictions on outflows (KA_OUT)	-40.268	-19.549	-13.826
	(43.972)	(91.297)	(83.271)
Capital account restrictions on inflows (KA_IN) x Gamma measure	4.044**		1.363
	(1.899)		(1.593)
Capital account restrictions on outflows (KA_OUT) x Gamma measure	-0.296		0.251
	(1.224)		(1.044)
Capital account restrictions on inflows (KA_IN) x VIX		11.594**	9.215**
		(4.810)	(4.202)
Capital account restrictions on outflows (KA_OUT) x VIX		-1.553	-1.884
		(3.146)	(2.961)
Observations	4706	4706	4706
Number of firms	181	181	181
R-squared within	0.653	0.655	0.655
R-squared between	0.691	0.692	0.692
R-squared overall	0.626	0.627	0.628
F	21.66	22.27	21.74

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